OFFICE OF RIVER PROTECTION
P.O. Box 450, MSIN H6-60
Richland, Washington 99352

DEC 0 9 2015

15-ECD-0059

Ms. Jane A. Hedges, Program Manager
Nuclear Waste Program
Washington State
Department of Ecology
3100 Port of Benton Blvd.
Richland, Washington 99354

Ms. Hedges:

RE-SUBMITTAL OF DANGEROUS WASTE DESIGN PACKAGE LAW-025, FOR THE LOW-ACTIVITY WASTE FACILITY THERMAL CATALYTIC OXIDIZER/SELECTIVE CATALYTIC REDUCER

References:

1. WA7890008967, "Dangerous Waste Portion of the Hanford Facility Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste, Part III, Operating Unit 10, 'Waste Treatment and Immobilization Plant.'"

2. ORP letter from K.W. Smith to J.A. Hedges, Ecology, "Submittal of Dangerous Waste Design Package LAW-025, Rev. 0, for the Low-Activity Waste Facility Thermal Catalytic Oxidizer/Selective Catalytic Reducer," 15-ECD-0038, dated August 14, 2015.

3. Ecology letter from D. McDonald to K.W. Smith, ORP, and P. McCullough, BNI, "Submittal of Dangerous Waste Permit (DWP) Design Package LAW-025, Rev. 0, Miscellaneous Unit for LAW Facility LVP System (Thermal Catalytic Oxidizer, Selective Catalytic Reducer, Electric Heater, and Heat Exchanger Skid)," 15-NWP-182, dated October 7, 2015.

4. Email from T. Hundal, AREVA, to D. Pfluger, BNI, "IQRPE Final Report (24590-CM-HC4-HXYG-00240-02-00012, Rev. 00A) for Pkg. LAW-025, LAW LVP Thermal Catalytic Oxidizer/Reducer Integrity Assessment (CCN: 283961), dated November 3, 2015.

This letter transmits revisions to five documents previously submitted to the Washington State Department of Ecology (Ecology) to comply with dangerous waste permit (DWP) requirements (Reference 1). These documents were submitted as part of the Low-Activity Waste (LAW) Facility DWP design package LAW-025 (Reference 2). Ecology accepted the LAW-025 design package for inclusion in the next public review (Reference 3). However, continued fabrication and fit-up of the Thermal Catalytic Oxidizer/Selective Catalytic Reducer required Bechtel National, Inc. to update the documents listed in the table below.

Document Number	Document Title	Reference 2 Revision Number	Attached Revision Number
24590-LAW-P1-P01T-00005	*LAW Vitrification Building General Arrangement Plan at El. 48 ft. – 0 in.*	5	6
24590-LAW-M6-LVP-00005002	*P&ID-LAW LAW Secondary Offgas/Vessel Vent Process System SCO/SCR Skid*	2	3
24590-CD-POC-MBT0-00007-01-00353	*LAW Thermal Catalytic Oxidizer – TCO General Arrangement*	00C	00E
24590-LAW-MKD-LVP-00012	*Mechanical Data Sheet LAW Catalytic Oxidizer/Reducer*	14	15
24590-LAW-3PS-MBTV-T0001	*Engineering Specification for LAW Thermal Catalytic Oxidizer/Reducer*	4	5

Attachment 1 provides these documents to Ecology to replace the revisions submitted with Reference 2, providing Ecology with the most-current revisions of these documents for the DWP approval process. The Independent Qualified Registered Professional Engineer has performed a review (Reference 4) of the changes to these documents and determined no impact is expected to the Independent Qualified Registered Professional Engineer report submitted with Reference 2.

Attachment 2 provides the U.S. Department of Energy, Office of River Protection and Bechtel National, Inc.'s certifications.

Ecology has reviewed these documents and comments have been dispositioned.

If you have any questions, please contact me, or your staff may contact Gae M. Neath, Environmental Compliance Division, (509) 376-7828.

Kevin W. Smith
Manager For

ECD:GMN

Attachments: (2)

cc: See page 3

cc w/attachs:
B.L. Curn, BNI
B.G. Erlandson, BNI
S. Greagor, BNI
M. McCullough, BNI
S.K. Murdock, BNI
D.C. Robertson, BNI
Administrative Record (WTP H-0-8)
BNI Correspondence
Environmental Portal, LMSI

cc w/o attachs:
J. Cox, CTUIR
R.S. Skeen, CTUIR
S.L. Dahl, Ecology
D. McDonald, Ecology
G.P. Bohnee, NPT
K. Niles, Oregon Energy
E.D. MacAlister, RL
R. Jim, YN

cc electronic:
J. Cantu, Ecology (2 hard copies)
A.S. Carlson, Ecology (8 hard copies, Public Review)
T.Z. Gao, Ecology
M.E. Jones, Ecology
J.K. Perry, MSA
A.C. McKarns, RL

Attachment 1
15-ECD-0059
(103 Pages)

Dangerous Waste Permit Package LAW-025,
Thermal Catalytic Oxidizer/Selective Catalytic Reducer

RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

ENGINEERING SPECIFICATION

FOR

LAW Thermal Catalytic Oxidizer/Reducer

Content applicable to ALARA? ☒ Yes ☐ No

ADR No.
24590-LAW-ADR-M-02-023

Rev
4

Specification changes retroactive? ☐ Yes ☒ No ☐ N/A (alpha revision or revision 0)

NOTE: Contents of this document are Dangerous Waste Permit affecting.

Quality Level
Q
DOE Contract No. DE-AC27-01RV14136

REV	DATE	BY	CHECK	AUTHORIZATION	AUTHORIZATION	APPROVER
5	30.Oct.15	D Rickettson Originator By: Dennis J Rickettson - dricket Org Name: Mechanical Systems Placed: Oct 27, 2015, 8:12 am	L Lewis Checked By: Lance Lewis - llewis2 Org Name: LAW MHRE Placed: Oct 27, 2015, 11:28 am	N/A	N/A	G Goolsby
4	05/15/15	D Rickettson	J Marsh	N/A	N/A	P Rajagopalan
3	10/21/14	D Rickettson	G Goolsby	N/A	N/A	S Kretzschmar
2	07/01/13	J Marsh	D Rickettson	N/A	N/A	O Omel
1	04/26/10	D Nelson	N Whitcomb	N/A	N/A	J Roth
0	03/01/10	D Nelson	N Whitcomb	N/A	N/A	J Roth

SPECIFICATION No.
24590-LAW-3PS-MBTV-T0001

Rev
5

Revision History

Revision	Reason for Revision	Q Specification Revision Only Margin Reduced?		CM Only
		YES	NO	N/A
0	Issued for purchase	N/A	N/A	N/A
1	This revision removes the full complement of NQA-1 requirements and substitutes a Quality Requirements Specification customized specifically for the LAW TCO procurement. This revision also reflects the removal of IEEE-323 environmental qualification requirements for LAW SS equipment. No revision bars were used for this revision. Issued for purchase.	☐	☒	☐
2	Incorporates TCN's 24590-QL-MRA-MBT0-00007-T0002, 4, 6, 7, 8, and 9. Incorporates SDDR's 24590-WTP-SDDR-MS-11-00054, 11-00200, 11-00298, 11-00299, 12-00094, 12-00110, 12-00167, 12-00168, 12-00173, 13-00001, 13-00006, 13-00015, 13-00023. On 04/10/13 the Supplier for the LAW TCO went out of business. The following specification sections were revised to address finishing the LAW TCO by the Completion Supplier. •Add section 1.2.15, defined work scope for the Completion Supplier •Add section 1.3.12, defined work scope for WTP. WTP will be responsible for seismic, thermal, ASME B 31.3 and ASME VIII calculations. •Revised the specification throughout changing "Supplier" to "Completion Supplier" where appropriate. • Revised the specification throughout deleting submittal requirements for seismic, thermal, ASME B 31.3 and ASME VIII analysis. •Add section 4.5, Defined Government Furnished Material (GFE) requirements for the Completion Supplier. •Rewrite section 5.1.4, defined ammonia gas pipe line connection requirements for the Completion Supplier. •Rewrite section 6.1.4, revised testing of rectangular flanges for Completion Supplier. •Delete section 10.2.7.1, contents on this section moved to new section 4.5. •editorial revision to Attachment JQ07, section 3.4.5.2.1, added ASTM A276, 316L, as required by TCN8 •Attachment JQ07 - Deleted the safety software requirements, added the cable separation requirements. •Added attachment 13 LAW design Status 06/26/13, for the Completion Supplier.	☐	☒	☐
3	Incorporated TCN's 24590-QL-MRA-MBT0-00007-T0010, and 11. Incorporated SDDR's 24590-WTP-SDDR-MS-13-00074, 14-00002, 14-00003, 14-00004, 14-00042, 14-00048, 14-00049, 14-00050, 14-00061, 14-00062 and 14-00064. Incorporated technical notes from MR, 24590-QL-MRA-MBT0-00007. The Completion Supplier and WTP were unable to qualify the majority of the partially fabricated TCO and ammonia air dilution skid for reuse. The options that allowed the Completion Supplier to refurbish the partially fabricated TCO and ammonia air dilution were removed. This	☐	☒	☐

		Q Specification Revision Only Margin Reduced?		CM Only
	general specification revision aligns the specification with the current fabrication plan. Aligning the specification with the current fabrication plan and incorporating previously approved changes (TCNs, SDDR & technical notes) does not reduce margin. Justification for margin statement. Margin was evaluated on the previously reviewed and approved changes. Fabrication options do not include margin, so deletion of fabrication options do not impact margin. Fabrication plans do not include margin, so margin is not impacted. Revision bars were not used for this general specification revision.			
4	Incorporated SDDR's 24590-WTP-SDDR-MS-14-00066, 14-00068, 14-00069, 14-00074, 14-00076, 14-00091, 15-00010, 15-00012, 15-00017, 15-00018, 15-00021, 15-00022, 15-00023 and 15-00025. Incorporated EIEs, 24590-LAW-EIE-MS-14-0079 & 14-0088. Strike out and or Revision bars were used to denote changes.	☐	☒	☐
5	Section 2.2.3, ASME B&PVC, section VIII-2004 was changed to VIII-2013. In section 2.3.11 the HEPA filter specification was deleted. Section 2.3.13, specification 24590-WTP-3PS-MV00-T0002 was added by ESQ group. Revised expansion joint requirements in sections 3.1.10, 3.1.11, 3.1.12 and 3.1.13. In Section 3.1.14 the verbiage relating to active safety functions was removed by the systems engineer. This work scope does not include components with an active safety function. Section 3.3, the word "mixing" was deleted. In section 3.4.7, the mass balance calculation is defined as "non-safety". Sections 3.4.9, 3.4.10 and 3.4.11 were deleted to align with the current work scope. Section 3.5 was revised to relocate the ammonia dilution skid to room L-0322A. Section 3.7.3.1 was revised to align with the current design shown on the P&ID. Section 3.7.3.3 the words "HEPA filter and" were deleted. Section 3.7.3.4 was deleted, HEPA filters are no longer in the work scope. Section 3.10.3 was revised to define the control narrative as non-safety and that the buyer will provide the control logic. In section 3.10.4 valves LVP-V-01548, LVP-V-01612, LVP-V-01618 and LVP-V-01620 were removed because they no longer have Hy-lok ends. Section 3.16.4.14 was revised to align with SDDR 15-00040. Section 3.16.4.15 was revised to align with SDDR 15-00041. Section 3.4.14.17 Deleted. Section 3.16.4 revised to align with current CGD plans. Sections 3.16.4.4, 3.16.4.5, 3.16.4.8, 3.16.4.12, 3.16.4.13 and 3.16.4.21, yellow metal inspection deleted by CGD group. Section 3.17.2 added bellows, LVP-BLWS-00080 and 00081. Section 3.17.13 deleted non Q items; solenoid valves, coalescing filters, rotometers and hose. Added sections 4.2.6 and 5.3.4. In section 6.1.3 the words "HEPA Filters for the HEPA housing may or may not be installed for testing" were deleted. In section 7.2.3 the word "filters" was deleted. Section 10.1 revised to define submittal requirements. Sections 10.2.5 and 10.2.7.2 revised to clarify requirements for C of Cs and MTRs. Deleted the sentence containing "Two times max system pressure" from attachment JQ07, section 3.8.3. Deleted "MS Access format" from attachment JQ07, section 11.2.2. The following SDDRs were incorporated by reference: 24590-WTP-SDDR-MS-15-00019, 15-00028, 15-00029, 15-00030, 15-00031, 15-00040, 15-00041, 15-00051, 15-00052, 15-00056, 15-00057 and 15-00060.	☒	☒	☒

		Q Specification Revision Only Margin Reduced?		CM Only
	Margin was evaluated on the previously reviewed and approved SDDRs. Changes to the specification paragraphs provide clarification to the complete supplier, margin is not impacted.			

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Contents

Attachments

Attachment JQ07 - *Instrumentation for Packaged Systems*
Attachment EKP0 - *Electrical Requirements for Packaged Systems*
Attachment NN00 - *Thermal Insulation for Mechanical Systems*
Attachment PS02 - *Shop Fabrication of Piping*
Attachment AFPS - *Shop Applied Special Protective Coatings for Steel Items and Equipment*
Attachment EEQ - *LAW TCO EEQ Guidance*

1. 24590-WTP-SRD-ESH-01-001-02, pages C.34-1 thru C.34-5, tailoring of ANSI-K61.1
2. 24590-WTP-SRD-ESH-01-001-02, pages C.26-1 thru C.26-7, tailoring of ASME-B31.3
3. Deleted
4. LAW Skid Interface Connections
5. Connection for Non-Routine Sample Extraction
6. Connection for Sample Extraction-Permanent Typical
7. Certificate of Analysis for BASF Catalysts, LLC (VOCat 300S)
8. LAW TCO & Ammonia/Air Dilution Skid Embed As-Built Elevations
9. Deleted
10. Deleted
11. Sample Certificate of Conformance
12. Deleted
13. Deleted

1 Scope

1.1 Project Description and Location

The Hanford Tank Waste Treatment and Immobilization Plant (WTP) is a complex of waste treatment facilities where the Department of Energy's (DOE) Hanford site tank waste will be pretreated and immobilized into stable glass form via vitrification. The WTP Contractor will design, build, and start up the WTP pretreatment and vitrification facilities for the US Department of Energy's (DOE) Office of River Protection (ORP). The waste treatment facilities will pre-treat and immobilize the Low-Activity Waste (LAW) and High-Level Waste (HLW) currently stored in underground storage tanks at the Hanford Site.

The Hanford Site occupies an area of about 560 square miles and is located along the Columbia River, north of the city of Richland. The WTP Facility will be constructed at the East End of the 200 East Area of the Hanford Site. Benton, Franklin, and Grant counties surround the Hanford Site.

1.2 Equipment, Material, and Services Required

This specification provides the requirements for the design, materials selection, appurtenances selection, quality control, quality assurance, inspection, fabrication, testing and labeling of an LAW Thermal Catalytic Oxidizer/Reducer (TCO) and the associated Ammonia/Air Dilution Skid.

The scope of work for the Completion Supplier includes work specifically defined in this specification and its addenda and attachments. Work shall include, but is not limited to, the following:

1.2.1 Low-Activity Waste Off-Gas Equipment: To include a Thermal Catalytic Oxidizer/Reducer Skid, LVP-SKID-00002, Ammonia/Air Dilution Skid, LVP-SKID-00003, and Ammonia-Air Dilution fan control panel (LVP-PNL-00003).

1.2.2 Deleted

1.2.3 Provide Material Test Reports (MTRs), welding procedures, removable insulation installation procedures, surface preparation and coating procedures, testing procedures, testing results, inspection results, and all other procedures and documentation required per this specification and its addenda and attachments.

1.2.4 Provide transportation, storage, and installation instructions for the Thermal Catalytic Oxidizer/Reducer and the Ammonia/Air Dilution Skid per manufacturer's recommendation and this specification.

1.2.5 Provide packaging and prepare the Thermal Catalytic Oxidizer/Reducers Skid, the Ammonia/Air Dilution Skid, control panels, gaskets, special tools (if required), and catalyst bed for shipment to the WTP site. Packaging shall be sufficient to allow indoor storage for a period of up to 12 months at the WTP site, without Buyer action except routine inspection. Environmental conditions for storage are found in Section 7.4 of this specification.

1.2.6 Provide special tools required for installation and maintenance.

1.2.7 Provide Material Safety Data Sheets (MSDSs) for the catalyst cartridges and any other potentially hazardous chemicals or materials which will be delivered to the Buyer.

1.2.8 Deleted

1.2.9 Procure and install thermal insulation. Provide installation procedures for removable insulation.

1.2.10 Deleted

1.2.11 Provide shop painting of carbon steel surfaces.

1.2.12 Deleted

1.2.13 Provide junction boxes to accommodate wiring to remote-mounted Completion Supplier control panel. The Completion Supplier shall provide wiring schedule, diagrams, and documentation to facilitate installation of wiring from equipment to remote control panel.

1.2.14 Deleted

1.3 Work by Others

Specific activities and materials excluded from the scope of this specification include:

1.3.1 Shipping to WTP jobsite

1.3.2 Material unloading and storage at jobsite

1.3.3 Installation labor

1.3.4 Foundation embeds and Surface Mounted Plates

1.3.5 Ammonia vapor supply to skid connection

1.3.6 Electric power supply

1.3.7 Off skid external wiring

1.3.8 External connection to the Buyer's instrumentation and controls

1.3.9 Containment Tent, portable High Efficiency Particulate Air (HEPA) filter exhauster

1.3.10 Grounding cable

1.3.11 Z Instruments, TE-0509 with thermowell, TE-0516 with thermowell, FE-0530, FE-0531, FE-0540, FE-0541, YV-0528 and YV-0538

1.3.12 WTP will provide the Seismic, Thermal, ASME Section VIII, and the ASME B31.3 piping analyses for the Thermal Catalytic Oxidizer/ Reducer skid and the associated Ammonia / Air Dilution skid.

1.4 Acronyms and Abbreviations

ADS	Ammonia Dilution Skid
AHJ	Authority Having Jurisdiction
AI	Analog Input
AISC	American Institute of Steel Construction
AO	Analog Output
ANSI	American National Standards Institute
ASD	Adjustable Speed Drive
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
AWS	American Welding Society
C&I	Control & Instrumentation

CM	Commercial
MTR	Material Test Report
COA	Certificate of Analysis
COTS	Commercial-Off-The-Shelf
DBE	Design Basis Event
DCS	Distributed Control System
DD	Device Description
DO	Digital Output
DRE	Destruction and Removal Efficiency
EJMA	Expansion Joint Manufactures Association
FT	Functional Test
FF	Foundation® Fieldbus
FMEA	Failure Mode and Effects Analysis
FTF	Filter Test Facility
GFE	Government Furnished Equipment
HEPA	High Efficiency Particulate Air
HLW	High Level Waste
ICN	Integrated Control Network
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
I/O	Input / Output
ISA	Instrument Service Air
LAW	Low Activity Waste
MACT	Maximum Achievable Control Technology
MDS	Mechanical Data Sheet
MR	Material Requisition
MSDS	Material Safety Data Sheet
MTBF	Mean-Time Between Failure
NACE	National Association of Corrosion Engineers
NDE	Non-Destructive Examination
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NMCF	Non-Modifiable Configurable Firmware
NOx	Oxides of Nitrogen
NRTL	Nationally Recognized Testing Laboratory
P&ID	Piping and Instrumentation Diagram
PCJ	Process Control System
PLC	Programmable Logic controller
PMI	Positive Material Identification
PPE	Personnel Protection Equipment
PPJ	Programmable Protection System
PQR	Procedure Qualification Record
PSA	Process Service Air
QAP	Quality Assurance Program
Q	Quality
QL	Quality Level
RFQ	Request for Quote
RPP	River Protection Project
RTD	Resistance Temperature Device

SBS	Submerged Bed Scrubber
SC	Seismic Category
SCO	Selective Catalytic Oxidation
SCR	Selective Catalytic Reduction
SDDR	Supplier Deviation Disposition Request
SIS	Safety Instrumented System
SS	Safety Significant
SSCs	Systems, Structures, and Components
SVOCs	Semi-Volatile Organic Compounds
TCO	Thermal Catalytic Oxidizer/Reducer
UL	Underwriters Laboratories, Inc.
VOCs	Volatile Organic Compounds
VSL	Vitreous State Laboratory
WAC	Washington Administrative Code
WESP	Wet Electro Static Precipitator
WPS	Welding Procedure Specification
WTP	Hanford Tank Waste Treatment and Immobilization Plant

1.5 Definitions

The equipment covered by this specification will be used in the WTP, where the following definitions are applicable:

Quality Level (QL): The quality level identifies the quality requirements to be applied to the equipment. The identified quality levels are Q (Quality), and CM (Commercial).

Seismic Category (SC): Specific requirements for each seismic category are defined in the reference document, Sections 2.3.21 of this specification.

Thermal Catalytic Oxidizer/Reducer Expert: One who has extensive knowledge regarding the characteristics and application of Thermal Catalytic Oxidizer/Reducer.

Cabinet: It is used interchangeably with the word "enclosure" within this specification.

Enclosure: A surrounding case constructed to provide a degree of protection to personnel against incidental contact with the enclosed equipment and to provide a degree of protection to the enclosed equipment against specific environmental conditions. An enclosure generally does not have any operational interface accessible from the exterior.

Panel: A type of enclosure that provides some kind of operational interface accessible from the exterior, without having to open the enclosure.

Rack: An open frame construction of angle, strut, channel, pipe, etc., designed to support the mounting of four or more instruments.

Non-Modifiable Configurable Firmware: The combination of commercial off the shelf hardware device, computer instructions, and data that resides as read-only software on that device. Non-Modifiable Configurable Firmware precludes modifications by the Buyer's staff, but can accept configuration parameters, via a set up process, to achieve specific functionality to meet the Buyer's requirements, provided features or capabilities such as advanced "scripting" or "coding" are not utilized. Non-modifiable configurable firmware can be adequately verified by testing the component of which it is an integral part.

1.6 Safety/Quality Classifications

1.6.1 Refer to the MDS in Section 2 of the MR for Safety Class, Quality Level, and Seismic Category classifications related to the LAW Thermal Catalytic Oxidizer/Reducer and the Ammonia/Air Dilution skid.

2 Applicable Documents

2.1 General

2.1.1 Work shall be done in accordance with the referenced codes, standards, and documents listed below, which are an integral part of this specification.

2.1.2 When specific chapters, sections, parts, or paragraphs are listed following a code, industry standard, or reference document, only those chapters, sections, parts, or paragraphs of the document are applicable and shall be applied. For the codes and standards listed in Section 2, the specific revision or effective date identified shall be followed. If a date or revision is not identified, the latest issue, including addenda, at the time of quotation, shall apply.

2.2 Industry Standards

2.2.1 Deleted

2.2.2 ASME B31.3 – 1996, *Process Piping Code*, as tailored in Appendix C of 24590-WTP-SRD-ESH-01-001-02, *Safety Requirements Document Vol. II* (see Attachment 2)

2.2.3 ASME B & PVC, Section VIII-2013, Division 1: *Rules for Construction of Pressure Vessels*

2.2.4 ASME Y14.100, *Engineering Drawing Practices*

2.2.5 ASTM – E84-08, *Surface Burning Characteristics of Building Materials*

2.2.6 Deleted

2.2.7 AWS D1.6-1999, *Structural Welding Code, Stainless Steel*

2.2.8 NEMA 250-2003, *Enclosures for Electrical Equipment (1,000 Volts Maximum)*

2.2.9 NFPA 70 – 1999, *National Electrical Code*

2.2.10 NFPA 497-1997, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*

2.2.11 UL 467-2007, *Standard for Safety Grounding and Bonding Equipment*

2.2.12 UL 508-2007, *Standard for Safety Electric Industrial Control Equipment*

2.2.13 UL 508A-2007, *Standard for Industrial Control Panels*

2.2.14 ANSI K61.1 - 1999, *Safety Requirements for the Storage and Handling of Anhydrous Ammonia*, as tailored in Appendix C of 24590-WTP-SRD-ESH-01-001-02, *Safety Requirements Document Vol. II* (see Attachment 1)

2.2.15 ASME AG-1 1997 with ASME AG-1a-2000 Addenda, Code on Nuclear Air & Gas Treatment

2.2.16 Deleted

2.2.17 ASME PTC-10-1997, Performance Test Codes on Compressors and Exhausters

2.2.18 ABMA 9-1990, Load Ratings and Fatigue Life for Ball Bearings

2.2.19 ABMA 11-1990, Load Ratings and Fatigue Life for Roller Bearings

2.2.20 ISO 3744-1995, Acoustics - Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Engineering Method in an Essentially Free Field over a Reflecting Plane

2.2.21 ISO 1940-1:2003, Mechanical Vibration - Balance Quality Requirements for Rotors In a Constant (Rigid) State-Part 1: Specification and Verification of Balance Tolerances

2.2.22 NEMA MG 1-1998, Motors and Generators

2.2.23 AMCA-210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

2.2.24 AWS D1.1-2000, *Structural Welding Code – Steel*

2.2.25 EJMA Ninth Edition with 2011 Addenda

2.2.26 29 CFR 1910, *Occupational Safety and Health Standards for General Industry*

2.2.27 1997 UBC, *Uniform Building Code*

2.2.28 ASME B16.10-2009, Face-to-Face and End-to-End Dimensions of Valves

2.3 Reference Documents/Drawings

2.3.1 24590-WTP-3PS-EVV1-T0001, *Engineering Specification for Low Voltage Adjustable Speed Drives*

2.3.2 Deleted

2.3.3 24590-WTP-3PS-G000-T0001, *Engineering Specification for Supplier Quality Assurance Program Requirements*

2.3.4 24590-WTP-3PS-G000-T0002, *Engineering Specification for Positive Material Identification (PMI) for Shop Fabrication*

2.3.5 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling and Storage Requirements*

2.3.6 Deleted

2.3.7 Deleted

2.3.8 24590-WTP-3PS-JQ00-T0004, *Engineering Specification for Management of Supplier Software*

2.3.9 24590-WTP-3PS-JXXE-T0003, *Engineering Specification for Commercial C&I Enclosures, Panels, Cabinets, and Racks*

2.3.10 *Deleted*

2.3.11 *Deleted*

2.3.12 24590-WTP-3PS-MV00-T0001, *Engineering Specification for Pressure Vessel Design and Fabrication*

2.3.13 24590-WTP-3PS-MV00-T0002, *Engineering Specification for Seismic Qualification Criteria for Pressure Vessels*

2.3.14 24590-WTP-3PS-MVB2-T0001, *Engineering Specification for Welding of Pressure Vessel, Heat Exchangers and Boilers*

2.3.15 24590-WTP-3PS-NWP0-T0001, *Engineering Specification for General Welding and NDE Requirements for Supplier Fabricated Piping*

2.3.16 24590-WTP-3PS-SS00-T0001, *Engineering Specification for Welding of Structural Carbon Steel*

2.3.17 24590-WTP-3PS-SS00-T0002, *Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel*

2.3.18 24590-101-TSA-W000-0009-195-00002, *Report - Small Scale Melter Testing for Allyl Alcohol Method Verification*

2.3.19 24590-WTP-LIST-CON-08-0001, *Restricted Materials List WTP Safety Assurance*

2.3.20 24590-LAW-M6-LVP-00005002, *P&ID - LAW Secondary Offgas / Vessel Vent Process System SCO / SCR Skid*

2.3.21 24590-LAW-MKD-LVP-00012, *24590-LAW-MX-LVP-SKID-00002 and 24590-LAW-MX-LVP-SKID-00003 - LAW Catalytic Oxidizer / Reducer*

2.3.22 24590-WTP-3PS-PB01-T0001, *Technical Supply Conditions for Pipe, Fittings, and Flanges*

2.3.23 Deleted

2.3.24 24590-LAW-M6-LVP-00005001, *P&ID - LAW Secondary Offgas / Vessel Vent Process System Ammonia Dilution Skid*

2.3.25 24590-WTP-3PS-MUMI-T0002, Low Voltage Induction Motors

3 Design Requirements

3.1 General

3.1.1 The Thermal Catalytic Oxidizer/Reducer and the associated Ammonia/Air Dilution unit is designed to selectively and primarily remove Volatile Organic Compounds (VOCs) and Oxides of Nitrogen (NO_X) from the offgas generated by the LAW melters.

3.1.2 The Thermal Catalytic Oxidizer/Reducer and the associated Ammonia/Air Dilution unit shall be designed per this specification, the applicable documents listed in Section 2 of this specification, and the MDSs in Section 2 of the MR.

3.1.3 The WTP facility is designed for a minimum service life of 40 years. Structural and pressure boundary components related to the Thermal Catalytic Oxidizer/Reducer and the associated Ammonia/Air Dilution units shall be engineered with a design life of 40 years. The Recuperative Heat Exchanger shall have a minimum service life of 15 years. Catalyst used in the Thermal Catalytic Oxidizer/Reducer shall have a minimum design life of one year. Other key mechanical components, such as the Electric Heaters, and fans shall have a minimum service life of five years with periodic maintenance.

3.1.4 Operation of the Thermal Catalytic Oxidizer/Reducer and the associated Ammonia/Air Dilution units shall be continuous for one year. Refer to MDSs in Section 2 of the MR for thermal cyclic conditions. All instruments in section 3.1.14 with a "Z" suffix have been removed from the Completion Supplier's scope.

3.1.5 Deleted

3.1.6 The maximum pressure drops across the Thermal Catalytic Oxidizer/Reducer shall be in accordance with the requirements of the MDSs.

3.1.7 The following requirements shall be met (responsibility of the Buyer):

- Pressure boundary shall be designed in accordance with the requirements of ASME B&PVC, Section VIII, Div. 1 and BUYER specification 24590-WTP-3PS-MV00-T0001, *Engineering Specification for Pressure Vessel Design and Fabrication. Code* stamp is not required
- Non-Destructive Examination (NDE) requirements for the pressure boundary shall be in accordance with the Buyer specification 24590-WTP-3PS-MV00-T0001, *Engineering Specification for Pressure Vessel Design and Fabrication.* See additional requirements for Design Level 2 (L-2) Vessels, Section 6.3
- Seismic analysis shall be per the Buyer's specification 24590-WTP-3PS-MV00-T0002, *Engineering Specification for Seismic qualification Criteria for Pressure Vessels*
- The structure supporting the pressure boundary shall be designed per BUYER specification 24590-WTP-3PS-MV00-T0002, Section 7.2.2, *Engineering Specification for Seismic Qualification Criteria for Pressure Vessels*

3.1.8 Penetrations in the pressure boundary (i.e. access doors, sample ports, etc.) shall be designed and reinforced in accordance with the requirements of ASME B&PVC, Section VIII, Div. 1, and the Buyer's specification 24590-WTP-3PS-MV00-T0001, Engineering Specification for Pressure Vessel Design and Fabrication.

3.1.9 Deleted

3.1.10 Circular expansion joints

Component Number	Nominal size	Design Pressure	Design Temperature	Design cycles
LVP-BLWS-00053	18 inch diameter	+15 psig / full vacuum	500F	100
LVP-BLWS-00061	18 inch diameter	+15 psig / full vacuum	500F	100
LVP-BLWS-00080	8 inch diameter	+15 psig / full vacuum	150F	100
LVP-BLWS-00081	8 inch diameter	+15 psig / full vacuum	150F	100

3.1.11 Combined Movements for LVP-BLWS-00080 and 00081

Component Number	Axial Compression	Axial Extension	Lateral	Angular
LVP-BLWS-00080	1.0 inch	0.5 inch	2.0 inches	2.0 degrees
LVP-BLWS-00081	1.0 inch	0.5 inch	2.0 inches	2.0 degrees

3.1.12 Circular expansion joints / bellows shall be designed and manufactured in accordance with ASME B31.3 and the Expansion Joint Manufacturers Association (EJMA) standard. Square or rectangular joints not specifically addressed by the Boiler & Pressure Vessel Code, ASME Section VIII, Division 1, shall meet the requirements within the latest version of the Expansion Joint Manufactures Association (EJMA) Standard. The bellows design shall meet all the design conditions and design life of the equipment. Stainless steel expansion bellows shall not be annealed after forming.

3.1.13 The Completion Supplier shall supply expansion joints (LVP-BLWS-00053 and 00061) for both the offgas process inlet and outlet connections. Expansion joints shall be one ply.

Analysis Condition, Movements	(Combined)	Required or Not Required
Compression Design	1.000 inch	Required
Lateral Design	0.5000 inch	Required
Angular Design	2 degrees	Required
Torsion	0.3 degrees	Optional, not a contract requirement

3.1.14 The following are the Safety Significant functions of the LAW Thermal Catalytic Oxidizer/Reducer and the Ammonia/Air Dilution units. An instrument has a "Z" suffix if it serves an active safety function. All instruments with a "Z" suffix have been removed from the Completion Supplier's scope.

a) Confinement of Melter Offgas: TCO housing, piping, and appurtenances shall be designed to maintain melter offgas confinement during normal operation, and during and after a seismic category III DBE. Structural failure of internals shall not breach confinement boundary.

b) Confinement of Ammonia: The ammonia and air dilution supply piping, valves, and appurtenances shall maintain confinement of ammonia during normal operation, and during and after a seismic category III DBE.

3.2 Offgas Treatment Functional Description of Major Components

Offgas is generated from the vitrification of radioactive waste in Joule heated ceramic melters.

3.2.1 LAW Thermal Catalytic Oxidizer/Selective Catalytic Reduction Unit:

The feed to the LAW Thermal Catalytic Oxidizer/Reducer is primarily melter offgas that has been treated by a Submerged Bed Scrubber (SBS), Wet Electrostatic Precipitator (WESP), HEPA Filters, and an Activated Carbon Bed Adsorber.

3.3 Basic Function

The Thermal Catalytic Oxidizer/Reducer unit shall consist of four primary components; a recuperative heat exchanger, electric heaters, VOC selective catalytic oxidation (SCO) bed, and a NO_X selective catalytic reduction (SCR) bed.

3.3.1 Recuperative Heat Exchanger

The recuperative heat exchanger is primarily employed to recover heat from the SCR hot exhaust gas for the Thermal Catalytic Oxidation/Reducer unit. The heat exchanger shall cool down the hot SCR exhaust gas and heat the incoming offgas.

3.3.2 Electric Heaters

The electric heaters are downstream of the recuperative heat exchanger and are employed to heat the offgas feed to the final desired oxidation and reduction temperatures. After startup, the electric heaters shall function as a trim control to raise the offgas temperature to the required oxidizing temperature. Required oxidizing and reduction temperatures shall be per performance criteria specified in Section 3.4 of this specification.

3.3.3 VOC Selective Catalytic Oxidation Unit

The SCO unit, containing oxidation catalyst, is downstream of the Electric Heaters and will oxidize volatile and semi-volatile organic compounds creating water and carbon dioxide. The residence time and number of catalyst beds shall be as specified in Section 3.4 of this specification.

3.3.4 NO_X Selective Catalytic Reduction Unit

The SCR unit, containing reduction catalyst, is downstream of the SCO and shall use ammonia injection to reduce the NO_X to Nitrogen, Oxygen, and water through catalytic reaction with ammonia.

3.3.5 Ammonia/Air Dilution System

The Buyer will supply ammonia gas to the LAW Ammonia/Air Dilution System. The Completion Supplier shall specify dilution air flow rates and pressures if required for the Ammonia/Air Dilution skid. The Completion Supplier shall supply necessary equipment required to meet performance requirements.

3.4 Performance

3.4.1 Refer to the Thermal Catalytic Oxidizer/Reducer MDSs for design data and gas stream properties.

3.4.2 The organic Destruction and Removal Efficiency (DRE) performance shall be based on inlet loadings specified in the MDSs.

3.4.3 The Thermal Catalytic Oxidizer/Reducer shall meet the DRE for Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds (SVOCs) as required in the MDSs as well as residence time and minimum oxidizing temperatures specified.

3.4.4 The NOx SCR unit shall meet the reduction efficiency at less than the specified ammonia slip concentration required in the MDSs.

3.4.5 Detection limits used to verify the Thermal Catalytic Oxidizer/Reducer guaranteed performance shall be based on the Buyer information (MDS General Note 9).

3.4.6 Deleted

3.4.7 The Completion Supplier shall provide the ammonia slip point within the mass balance calculation (this calculation is defined as non-safety) (excess ammonia beyond that needed for the reaction) for SCR performance.

3.4.8 The ammonia slip exiting the LAW systems shall be specified by the supplier to meet the NOx reduction efficiencies specified in Section 3.4.4 of this specification.

3.4.9 Deleted

3.4.10 Deleted

3.4.11 Deleted

3.5 Design Conditions

3.5.1 Refer to the Thermal Catalytic Oxidizer/Reducer and the associated Ammonia/Air Dilution MDSs in Section 2 of the MR.

3.5.2 The embed plate design location and elevation for the TCO skid is shown on drawing 24590-LAW-DB-S13T-00135, drawing coordinate (E-6.5 for the TCO skid). The design elevation for the top of the embed plates is 48 feet - 0 inches, in plant elevation. The existing embed elevations vary slightly from plate to plate. Attachment 8 lists embed As-Built elevations.

3.5.3 Deleted

3.5.4 The Buyer's existing embed plates for the TCO skid are coated carbon steel plates, stock code: EBPNS02CD, shown on drawing 24590-BOF-DD-S13T-00001. When attachments are welded to the existing embed plates, the Buyer site welding procedures require inorganic zinc primer to be removed within 2- 4 inches of the weld area. Only carbon steel can be welded to the carbon steel embed plates where the inorganic zinc primer has been removed.

3.5.5 Thermal Catalytic Oxidizer / Reducer Skid, LVP-SKID-00002, will be field welded to carbon steel or stainless steel surface mounted plates provided by the Buyer. The Buyer supplied surface mounted plates will be bolted with through bolts and installed with sandwich plates through the facility floor.

Locate the inlet bellows flange, LVP-BLWS-00053, 12 feet - 6 inches above the base of the Thermal Catalytic Oxidizer / Reducer Skid, LVP-SKID-00002.

Locate the outlet bellows flange, LVP-BLWS-00061, 12 feet - 6 inches above the base of the Thermal Catalytic Oxidizer / Reducer Skid, LVP-SKID-00002.

The Ammonia / Air Dilution Skid, LVP-SKID-00003, will be field welded to carbon steel or stainless steel surface mounted plates provided by the Buyer. The surface mounted plates will be bolted to the facility floor or bolted to the existing embeds.

3.5.6 The 2 inch thick surface mounted plates shown on drawing 24590-LAW-DD-S13T-00306 have been installed in the LAW facility. Each plate is secured with (4) 1 1/2 inch diameter threaded rods. On the 48' elevation side of the surface mounted plate the threaded rods are secured with double nuts and washer. During the installation of these surface mounted plates the 1 3/4 inch core drilled holes had to be positioned to miss reinforcing bar. The installed centerline location of the threaded rods with double nuts and washer are shown on drawing, 24590-LAW-DD-S13T-00313. As detailed on this drawing the rods with doubled nuts and washer stick up 3 7/8 inches to 4 1/2 inches above the top of the plate.

3.6 Environmental Conditions

3.6.1 The Thermal Catalytic Oxidizer/Reducer Skid and Ammonia/Air Dilution Skid will be located indoors. Refer to MDSs for specific room environmental design conditions.

3.6.2 Deleted

3.6.3 Deleted

3.6.4 The Completion Supplier shall provide and document Environmental Qualification per the requirements in Attachment EEQ.

3.7 Mechanical Requirements

3.7.1 General

3.7.1.1 Due to access restrictions for installation, the Thermal Catalytic Oxidizer/Reducer unit shall be fabricated in such a manner that will allow delivery in sections that comply with the bounding dimensions specified in MDSs. Each section of the Thermal Catalytic Oxidizer/Reducer shall be skid mounted.

3.7.1.2 The catalyst bed shall be designed for manual removal and replacement. The catalyst bed shall be designed to meet service life requirements outlined in Section 3.1.3 of this specification. The weight of a catalyst module is expected to be 60 to 70 pounds. When weights exceed 50 pounds, lifting beams, catalyst removal tools, or rigs shall be designed and supplied by the Completion Supplier.

3.7.1.3 The Completion Supplier shall provide transitions for connection to the Buyer's piping and gas analyzer instrumentation. All flanges required for connection to the Buyer's piping and gas analyzers shall be raised face flanges and shall be welded to the pipe (no threaded connections allowed). See Attachment 4 (LAW Skid Interface Connections). See also Attachments 5 and 6 (Connection for Non-Routine Sample Extraction and Connection for Sample Extraction - Permanent Typical, respectively) for non-routine and permanent analyzer connection details.

3.7.1.4 Deleted

3.7.1.5 NOT USED

3.7.1.6 Deleted

3.7.1.7 NOT USED

3.7.1.8 A containment tent or series of containments tents will be erected by the Buyer to control the work area for catalyst removal and replacement after permanent installation of the TCO units. The Buyer will supply and set up a portable HEPA filtered exhauster for containment tent ventilation with discharge port monitoring. The TCO unit will be ventilated using the Buyer's permanently installed process fans. Prior to catalyst removal, the TCO unit air will be sampled using a pre-installed sample tap. The air sample will be used to determine the level of airborne radioactive material inside the TCO unit. After the air samples are taken and deemed acceptable, removal of the catalyst subassembly will proceed.

3.7.1.9 The Completion Supplier shall supply the following for the TCO unit:

One 1-inch air sample tap per TCO unit. Include one 1-inch full port ball valve. The accessible end of the 1-inch ball valve shall include a cap or blind flange. There shall be at least 3 inches of clearance, for tightening bolts, between the insulating jacketing and the underside of the flange.

3.7.1.10 Catalyst removal / installation:

The catalyst bed (s) shall be designed for manual removal and replacement without entering the TCO unit for contact maintenance.

3.7.1.11 To facilitate process troubleshooting and to obtain additional data during testing and operations, the Completion Supplier shall supply the following for each TCO unit:

One sample port between each of the VOC catalyst beds to be used to measure offgas concentrations during non-routine evolutions. Sample ports shall be located to minimize flow disturbance and not interfere with the manipulation of the catalyst access doors. The location shall consider optimum accessibility. However, it is acceptable to locate the sample ports on the top of the TCO. Include ball valve, blind flange, gaskets, and bolts for each sample port. See Attachment 5 (Connection for Non-Routine Sample Extraction) for temporary connection details.

3.7.2 Recuperative Heat Exchanger

3.7.2.1 Unless otherwise specified, the heat exchanger pressure boundary shall be designed in accordance with ASME B&PVC, Section VIII, Division 1.

3.7.2.2 Deleted

3.7.2.3 Body flanges that allow for total unit replacement

3.7.2.4 Deleted

3.7.2.5 Deleted

3.7.2.6 Bolted connection to skid support frame

3.7.2.7 Heat exchangers shall be designed for full differential pressure, with one side at the design pressure and the other side at atmospheric pressure.

3.7.3 Ammonia/Air Dilution Equipment

3.7.3.1 Design and fabrication of ammonia piping and valves shall be in accordance with ANSI K61.1 and ASME B31.3 (as tailored in Attachment 1 & 2, respectively), and Attachment PS02 *LAW TCO Customized PS02*.

The following items, located on the ammonia dilution skid, shall be labeled as "suitable for ammonia" by the manufacturer of the item or the Completion Supplier; V-01570, YV-0560, PCV-0527, V-01559, V-72325, PT 0564, FE-0529, AV-0523, V-01557, V-01554, and FE-0539.

3.7.3.2 Deleted

3.7.3.3 The Completion Supplier shall supply, test, and deliver HEPA housings for the LAW ammonia dilution system in accordance with MDSs.

3.7.3.4 Deleted

3.7.3.5 HEPA Filter housings shall be provided in accordance with the MDS listed in Section 2.1 of the Material Requisition. Supplier submittals shall be as follows:

1 Submit procedure for Pressure Decay Test, ASME AG-1 1997 with AG-1a-2000 addenda, Article III-4200 (prepared with guidance given in AG-1 mandatory Appendix TA-III). Perform test on HEPA housings. Test duration shall be 15 minutes.

2 Submit procedure for Structural Capability Test, ASME AG-1 1997 with AG-1a-2000 addenda, TA-3422, (prepared with guidance given in AG-1 mandatory Appendix TA-II). Perform test on HEPA housings.

3 Recommended spare parts for the HEPA housings.

4 Operation and maintenance manuals for the HEPA housings.

3.7.3.6 The Completion Supplier shall supply centrifugal fans for the LAW ammonia/air dilution system. If the Completion Supplier determines airflow cannot be adequately controlled using control valves and that adjustable speed drives (ASD) are required, then the ASDs shall be in accordance with 24590-WTP-3PS-EVV1-T0001, *Engineering Specification for Low Voltage Adjustable Speed Drives*. Centrifugal fan Data Sheets will not be supplied by the Buyer. The Completion Supplier shall create and submit Centrifugal fan Data Sheets outlining performance requirements as specified by the Completion Supplier. Applicable design conditions and mechanical requirements shall be outlined on the Centrifugal fan Data Sheets.

3.7.3.7 Fans shall be capable of performing at the conditions shown on the fan data sheets. Fan performance ratings shall be based on AMCA-210 standard air condition. Materials of construction used shall be compatible with the effluent being handled.

3.7.3.8 Fan/motor assemblies shall be complete with all components and accessories fully assembled, wired, and skid mounted requiring only connection to the Buyer's electrical power and control systems, and interconnecting piping. Fan/motor assemblies shall be self-supporting, capable of carrying the static loads of the fan components and the stress imposed during shipment, installation, and operation.

3.7.3.9 Fans shall be designed and constructed for low leakage. Fans shaft seal(s) shall be low leakage with an external air purge.

3.7.3.10 Bearing rating life shall be established in accordance with ABMA 9 or 11, as applicable.

3.7.3.11 The Completion Supplier shall fill in and submit the "Electrical Data Sheet Low Voltage Induction Motor" contained in specification 24590-WTP-3PS-MUMI-T0002, for Fans LVP-FAN-00001 and LVP-FAN-00002.

3.7.3.12 The Completion Supplier shall fill in and submit the "Electrical Data Sheet Adjustable Speed Drive" contained in specification, 24590-24590-WTP-3PS-EVV1-T0001, for Fans LVP-FAN-00001 and LVP-FAN-00002.

3.7.3.13 Fan sound pressure level shall not exceed 85 dB (A) at 3-feet. If sound power exceeds 85 dB (A) at 3-feet, the Completion Supplier shall obtain the Buyer permission to proceed in the form of an SDDR stating estimated sound power level.

3.7.3.14 To achieve duty / standby configuration for the Buyer, Ammonia Dilutions Fans LVP-FAN 00001 and LVP-FAN-00002 shall be powered on separate 480V power feeds.

3.7.3.15 Electric motors shall be in accordance with NEMA MG-1. Motors shall be totally enclosed fan cooled type, unless motors are small and otherwise environmentally protected. Motor drive combination shall be suitable for operation for the design conditions shown on the Completion Supplier's fan data sheets. Each motor shall have a controller or drive.

3.7.3.16 For the fan, the following shall be submitted for the Buyer's review and information:

3.7.3.16.1 The Completion Supplier's recommended accessibility and maintenance requirements.

3.7.3.16.2 Performance test reports.

3.7.3.16.3 Sound test reports.

3.7.3.16.4 Deleted

3.7.3.17 Deleted

3.8 Loading

3.8.1 The Thermal Catalytic Oxidizer/Reducer (LVP-SKID-00002) and the associated Ammonia/Air Dilution assembly shall be self-supporting, capable of carrying the static loads of components and the stress imposed during shipment, installation, and operation.

3.8.2 Deleted

3.8.3 The Buyer will provide a seismic analysis in accordance with their approved processes and procedures.

3.8.4 Deleted

3.8.5 The Thermal Catalytic Oxidizer/Reducer units shall be designed in accordance with the nozzle load requirements as specified in the MDSs in Section 2 of the MR.

3.9 Electrical Requirements

3.9.1 Electrical components and appurtenances furnished with the Thermal Catalytic Oxidizer/Reducer and the associated Ammonia/Air Dilution units shall conform to the requirements of Attachment EKP0. Electrical components shall also meet applicable sections of NFPA 70-1999 and requirements outlined in NFPA 497-1997.

3.9.2 NOT USED

3.9.3 The Buyer will supply only 480V 3-wire wye-grounded power circuits. These shall connect to terminals in NEMA 4X-enclosed disconnecting devices mounted on the equipment skids. Flexible conduit connections to the skid disconnecting devices shall be used. All fan and heater circuits, and power and control circuits, shall be distributed electrical power from these power disconnecting devices. All branch circuits shall include applicable over-current protection devices. The Completion Supplier shall include in their equipment all motor and heater controllers, including their control circuits and devices. All motors shall be totally enclosed fan cooled type, unless otherwise environmentally protected. If the Completion Supplier's components are rated for a lower voltage, the Completion Supplier shall provide the components necessary to supply the lower voltage and circuit protection devices. All distribution circuits requiring disconnecting means for maintenance and isolation, including combination controllers, to prevent complete shutdown of the Buyer's power circuits, shall be provided by the Completion Supplier. Electric heaters shall be of the element type and mounted on removable flanged plates for ease of maintenance.

3.9.4 Electrical enclosures shall be NEMA 4X rated.

3.9.5 The Thermal Catalytic Oxidizer/Reducer control panel (LVP-PNL-00003) components shall be UL 508 listed and certified. Control panels as a whole shall be UL 508A labeled.

3.9.6 NOT USED

3.9.7 Provide bolted compression type 2/0 terminal lugs at diagonally opposite corners of the TCO skid and the ammonia dilution skid for connection by the Buyer to the area ground grid. The Buyer uses 2/0 AWG stranded copper for the area ground grid.

3.9.8 The Completion Supplier shall provide total electric load for the Thermal Catalytic Oxidizer/Reducer.

3.9.9 The Completion Supplier shall provide a functional description of the electrical operation of the skids as well as single line, schematic, wiring, layout, and interconnection diagrams. In addition, catalog cut sheets, recommended spare parts, and electrical loads as detailed in Attachment EKP0, Section 9. *Documentation and Submittals.*

3.10 Instrumentation and Control Requirements

3.10.1 Instrumentation and controls furnished with the Thermal Catalytic Oxidizer/Reducer and the associated Ammonia/Air Dilution units shall meet the instrumentation and control requirements as stated in Attachment JQ07. The Buyer shall provide the appropriate ABB control system components (i.e. I/O modules, power supplies) to the Completion Supplier for fabrication into the Completion Supplier's control panel (LVP-PNL-00003) as described in Section 3.4.2 of Attachment JQ07. The Completion Supplier shall provide non-ABB manufactured equipment (fiber optic converters, fiber optic patch cables and plates, terminals, circuit breaker, wiring, etc.) and panel fabrication.

3.10.2 The Completion Supplier shall design the control panel (LVP-PNL-00003) to utilize the ABB control system equipment and provide a panel arrangement drawing with Bill of Material identifying all parts to be provided by the Buyer. The Completion Supplier shall provide an I/O list on the panel arrangement drawing for all instruments. Reference Buyer's P&IDs in Section 2 of the MR for additional information regarding instrument locations and types.

3.10.3 The Completion Supplier shall provide a non-safety control narrative, logic drawings, termination drawings, and related items as specified in Attachment JQ07 for normal (PCJ).

The Buyer shall provide programming for normal operation (PCJ) via software included with the Buyer supplied ABB components. The Buyer shall provide the control logic, controller, software, and attend and support the functional test of the equipment at the Completion Supplier's facility.

3.10.4 In-line instruments shall be wired to the skid edge. Wiring shall terminate in a junction box. On the LAW TCO the following valves shall end with a Hy-Lok tubing connection: LVP-V-01609, LVP-V-01610, LVP-V-01613, LVP-V-01614, LVP-V-01615 and LVP-V-01616.

On the LAW Ammonia dilution skid the instrument tubing shall run to a bulk head plate. Provide Hy-Lok tubing end connections at the WTP / Completion Supplier interface.

3.10.5 NOT USED

3.10.6 Management of the Completion Supplier software shall be governed by 24590-WTP-3PS-JQ00-T0004, *Engineering Specification for Management of Supplier Software.*

3.11 Lifting Requirements

3.11.1 Lifting lugs shall be installed on the Thermal Catalytic Oxidizer/Reducer and Ammonia/Air Dilution skid packages for lifting and handling. The Completion Supplier shall identify the weight and center of gravity of each package. All lifting points shall be designed in accordance with the requirements of the Buyer specification 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling, and Storage Requirements.*

3.11.2 Lifting eyes or lugs shall be certified to be suitable for the safe, lifting and handling of the equipment without distortion or damage to the components.

3.11.3 Deleted

3.11.4 Lifting lugs must accept standard commercial lifting equipment. Chain blocks or braiding shall not be permitted.

3.11.5 The lifting lugs for the packages must be accessible from the top, without removal of components or covers.

3.11.6 The Buyer will provide calculations for the lift lug design.

3.12 Thermal Analysis Requirements

3.12.1 Deleted

3.12.2 Refer to MDS for thermal analysis technical information and heat loss requirements (i.e. thermal conductivity values, room temperatures, etc.).

3.12.3 The thermal analysis, by the Buyer, will include the effects of stresses resulting from potential variations in temperatures due to startup, normal operation, shutdowns, and thermal cycling of the Thermal Catalytic Oxidizer/Reducer. Analysis shall show that the Thermal Catalytic Oxidizer/Reducer is adequate for the design life specified in Section 3.1.2 of this specification. Analysis shall also establish design temperature of the TCOs.

3.12.4 The thermal analysis, by the Buyer, will include thermal expansion of the Thermal Catalytic Oxidizer/Reducer and resulting nozzle loadings in X, Y, and Z planes with deflections at normal operating conditions and design conditions.

3.12.5 The thermal analysis, by the Buyer, will determine the thickness and extent of insulation required on the sides, ends, top, and bottom of the Thermal Catalytic Oxidizer/Reducer to

ensure that the insulation jacket temperature and all exterior uninsulated portions with potential for personnel exposure do not exceed 140 °F at maximum design temperature.

3.12.6 The thermal analysis, by the Buyer, will determine the thickness and extent of insulation required on the bottom of the Thermal Catalytic Oxidizer/Reducer so that the temperature of the concrete does not exceed 150 °F.

3.12.7 Deleted

3.12.8 Deleted

3.12.9 Deleted

3.13 Deleted

3.13.1 Deleted

3.13.2 Deleted

3.13.3 Deleted

3.13.4 Deleted

3.13.5 Deleted

3.14 Accessibility and Maintenance

3.14.1 The Buyer's layout allows for necessary access and space requirements to facilitate maintenance during normal plant operation or scheduled shutdown.

3.14.2 The Completion Supplier's recommended accessibility and maintenance requirements for each piece of equipment shall be included in the Completion Supplier's design and shown on the layout drawings. Layout drawings shall show scaled clearances as dotted areas around and in front of all electrical equipment, components, and control panels. These areas shall be as required in the National Electrical Code.

3.14.3 The Completion Supplier shall provide instructions and frequency of maintenance including lubrication, rotation, heating, and any other type of preventative maintenance that will preserve the equipment until the time it is put into operation, including:

- Up to 12 months indoor storage prior to installation
- Deleted
- Indoor (installed) but not operating preservation maintenance and inspection schedule
- Operating preservation maintenance and inspection schedule

Frequency of inspection and maintenance intervals during operation shall be in accordance with equipment the Completion Supplier's recommendations.

3.14.4 Deleted

3.14.5 Deleted

3.14.6 Deleted

3.14.7 Deleted

3.15 Software Requirements

See Section 3.5 in Attachment JQ07 for specific software requirements.

3.16 Testing and Inspection Requirements

3.16.1 The Completion Supplier shall submit un-priced Purchase Orders with attachments showing flow down of requirements to engineering under document category 33.0, on the G-321-E form. The Completion Supplier is only required to submit the un-priced POs that contain items that will be used in an application that has been designated as "Q" by the Buyer.

3.16.2 The Completion Supplier shall provide fabrication drawings with a Bill of Material. The Bill of Material shall include the WTP Quality Level (Q or CM). The Buyer will determine the WTP Quality level during the drawing review process.

3.16.3 Deleted

3.16.4 Testing and Inspection Requirements for LAW TCO & Ammonia / Air Dilution Skid Components

Testing and inspection requirements are derived from the related CGD plan as developed by the Procurement Engineering Group. For completeness of project records the Completion Supplier shall submit the Inspection, examination and test results to the Buyer via the G-321-E Document Category 33.0.

3.16.4.1 General Requirements for Components Listed in this Section

I. Testing and inspection activities listed herein are derived from the BNI Commercial Grade Dedication plans. In some instances, the tests may be equivalent to tests required in other sections of this specification. If this is the case, a duplication of the test or inspection is not necessary as long as the test or inspection fulfills both requirements. All other tests and inspections listed in this section are strictly for the verification of critical characteristics.

II. Inspect all supplier documentation for compliance with the purchase order requirements and verify that all components in a single line item of the PO have been manufactured and supplied from the same heat/lot of the base material, to the greatest extent possible. If there are different heat/lots for a single line item it may have an impact on the sampling to be performed for testing and inspections. (see VIII below)

III. PMI (OES or XRF), hardness, proof load and/or tensile testing shall be performed by a laboratory that is accredited by one of the following organizations –
-A2LA
-NVLAP
-IAS
-ACLASS
-PJLA
-L-A-B
The specific test must be included in the scope of the current certification/accreditation at the time the test is performed as verified on the accrediting organization's website. The purchase order for testing at an accredited laboratory shall require that tests be performed in accordance with the accredited program. The lab results must contain a statement that the test(s) were performed in accordance with their accredited program. If no labs with this accreditation are available, the Buyer shall be advised of the lab that the Completion Supplier will use with sufficient notice to allow for surveillance activities of the tests by the

Buyer's representative. The Completion Supplier is also allowed to perform any or all of these tests after the successful completion of a CG survey in which the capability of the supplier to perform the tests is assessed and found to be acceptable.

IV. The following chemical constituents have been identified as critical to the materials listed below in order to perform their intended safety function –
304/304L SS – Cr, Ni
316/316L SS – Cr, Ni, Mo
347 SS – Cr, Ni, Cb
Incoloy 800 – Ni, Cr
These chemical constituents shall be tested for and individually identified on the test results along with the results of the test.

V. Perform tensile, hardness and proof load testing per ASTM A370. Leeb hardness testing to be performed in accordance with ASTM A956.

VI. Perform chemical verification testing per ASTM A751.

VII. Sampling for tests and inspections found in this section shall be performed per the guidance found in EPRI TR-017218. Accept on 0 defects and reject on 1 or more defects.

VIII. Each individual lot of material shall be sampled as specified below. A lot of material is defined as a single heat or run of material that is cast, extruded, or otherwise formed from a common batch of raw materials.

IX. Pressure testing, hydrostatic or pneumatic, shall be performed in accordance with Buyer approved procedures. The Buyer shall be notified of an impending pressure test to allow for surveillance activities by the Buyer's representative.

X. All inspection, examination, and test results shall be submitted to the Buyer for review within a reasonable time frame after performance of the inspection, examination, or test. The code or standard to which the test or inspection was performed and against which the results were verified shall be listed along with the results of the test, examination, or inspection.

XI. When a service is provided by a 3rd party entity (waterjet cutting, machining, etc.) that has not been evaluated by BNI, traceability of the item/material must be ensured by having a quality representative from the Completion Supplier visit the sub supplier to witness the first operation of the service (cutting, Marking, segregating...). Completion Supplier is to perform additional surveillances depending on the results of the first surveillance and the level of rigor with which the sub-supplier maintains the material traceability.

3.16.4.2 Testing and Inspection Requirements for **Pipe, Fittings and Flanges** to be performed by the Completion Supplier

All testing and inspections shall be performed, as detailed below, to verify compliance with ASME SA403, SA312 and SA182, SA480, SA961, ASME B16.11, ASME B16.5, ASME B16.9 and data sheets, as applicable.

INSPECTION REQUIREMENTS

Visual Inspection

Inspect each item to confirm that the material marking/identification is in accordance with the applicable ASTM/ASME specification, is clearly readable, and has no indication of re-marking by other parties. For the blank flanges to be used for destructive testing, the

following markings shall be present on each flange- heat #, manufacture's name or trademark, material, & size.

Sampling is not permitted.

Dimensional Inspection

Perform dimensional inspection of the pipe, fittings, flanges, and flow conditioner that are to be used in production as follows:

Pipe- Wall thickness at each end of the pipe

Pipe Fittings- Wall thickness at each end

End to End and / or End to Centerline

Flange- Thickness

Bore Diameter

Flow Conditioner- Outside Diameter

Thickness

Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan.

TESTING REQUIREMENTS

Tensile / Yield/Elongation Testing

Perform tensile, yield, and elongation testing of the pipe, fittings, and flanges (except pipe caps or plugs)

Sample per plan found in EPRI TR-017218 Table 2-2, Recommended Destructive Test and Inspection Sampling Plan.

Note: Flow conditioner is excluded from this testing

Chemical Composition Testing/Verification

Perform PMI on the pipe, fittings, flanges, and flow conditioner.

Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan.

3.16.4.3 Testing and Inspection Requirements for the **ADS fans** to be performed by the Completion Supplier

All testing and inspections shall be performed, as detailed below, to verify compliance with Section 3.17.12 of this specification and other purchasing document requirements.

INSPECTION REQUIREMENT

Visual Inspection

Inspect the fans and related documentation as received from the supplier for conformance with the purchasing documents.

Sampling is not permitted.

TESTING REQUIREMENT

Pressure Boundary Integrity Testing/Verification

Perform bubble leak detection test to verify that the housing and flanges are able to withstand the pressures of the air supply line of the ammonia dilution skid. The test will be conducted with the fan off. The acceptance criteria shall be no bubble growth in the flanged and/or gasketed joints

Sampling is not permitted.

3.16.4.4 Testing and Inspection Requirements for **Butterfly Valves** to be performed by the Completion Supplier

All testing and inspections shall be performed to verify compliance with ASTM A351, ASTM A693or ASTM A564, ASME B16.34, API 598 and API 609 as applicable.

INSPECTION REQUIREMENTS

Visual Inspection - Material Markings/Identification

Inspect each valve to confirm that the valve marking/identification is in accordance with purchasing documents is clearly readable and has no indication of re-marking by other parties.

Sampling is not permitted.

TESTING REQUIREMENT

Chemical Composition Testing/Verification

Perform PMI on the body

Sampling is not permitted.

Pressure Boundary Integrity Testing/Verification

Perform shell pressure test on all valves per ASME B16.34 Section 7. The performance of this test will use the system design pressure in lieu of the 38 C (100 F) pressure rating. No less than 1.5 times the system design pressure for hydrostatic test, or 1.1 times the system design pressure for pneumatic test, according to the location of the item tested.

Sampling is not permitted.

3.16.4.5 Testing and Inspection Requirements for **Ball Valves** to be performed by the Completion Supplier

All testing and inspections shall be performed to verify compliance with ASTM A351, ASME B31.3, B16.34, and API 598, as applicable.

INSPECTION REQUIREMENTS

Visual Inspection - Material Markings/Identification

Inspect each valve to confirm that the valve marking/identification is in accordance with purchasing documents, is clearly readable, and has no indication of re-marking by other parties.

Sampling is not permitted.

TESTING REQUIREMENTS

Chemical Composition Testing/Verification

Perform PMI on all valve bodies and end connections.

Sampling is not permitted.

Pressure Boundary Integrity Testing/Verification

Perform shell pressure test per ASME B16.34, Section 7. The performance of this test will use the system design pressure in lieu of the 38 C (100 F) pressure rating. No less than 1.5 times the system design pressure for hydrostatic test, or 1.1 times the system design pressure for pneumatic test, according to the location of the item tested.

Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan.

3.16.4.6 Testing and Inspection Requirements for **Pressure Regulator** to be performed by the Completion Supplier

All testing and inspections shall be performed to verify compliance with ASTM A351, ASME B31.3, and B16.34, as applicable.

INSPECTION REQUIREMENTS

Visual Inspection - Material Markings/Identification

Inspect pressure regulator to confirm that the marking/identification is in accordance with purchasing documents, is clearly readable, and has no indication of re-marking by other parties.

Sampling is not permitted.

TESTING REQUIREMENTS

Chemical Composition Testing/Verification

Perform PMI on regulator body.

Sampling is not permitted.

Pressure Boundary Integrity Testing/Verification

Perform pressure test, the performance of this test will use the system design pressure, no less than 1.5 times the system design pressure for hydrostatic test, or 1.1 times the system design pressure for pneumatic test, according to the location of the item tested.

Sampling is not permitted

3.16.4.7 Testing and Inspection Requirements for **Y- Strainer** to be performed by the Completion Supplier

All testing and inspections shall be performed to verify compliance with ASTM A351 and ASME B31.3 Section 345, as applicable.

INSPECTION REQUIREMENTS

Visual Inspection - Material Markings/Identification

Inspect the strainer to confirm that the marking/identification is in accordance with purchasing documents, is clearly readable, and has no indication of re-marking by other parties.

Sampling is not permitted.

TESTING REQUIREMENTS

Chemical Composition Testing/Verification

Perform PMI on strainer body and bolted cover.

Sampling is not permitted.

Pressure Boundary Integrity Testing/Verification

Perform pressure test, the performance of this test will use the system design pressure, no less than 1.5 times the system design pressure for hydrostatic test, or 1.1 times the system design pressure for pneumatic test, according to the location of the item tested.

Sampling is not permitted.

3.16.4.8 Testing and Inspection Requirements for the **Thermowells** to be performed by the Completion Supplier

All testing and inspections shall be performed, as detailed below, to verify compliance with purchasing documents, ASME Section VIII, Div. 1, UG-100, and ASME B31.3 Section 345 and other applicable specifications.

INSPECTION REQUIREMENT

Visual Inspection

Inspect the thermowells and related Completion Supplier documentation for compliance with the purchasing documents.

Sampling is not permitted.

TESTING REQUIREMENT

Chemical Composition Testing/Verification

Perform PMI on the flanged thermowells (flange and well body) and socket weld thermowells (well body) to verify conformance with the applicable material specifications.

Tightened sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test and Inspection Sampling Plan.

Where PMI is destructive, utilize Destructive sampling per EPRI TR-017218 Table 2-2 on per lot basis. Lot is established by single line item per single manufacture or single heat number.

Pressure Boundary Integrity Testing/Verification

Perform pressure test on the thermowells per ASME B31.3, (socket weld thermowell) and ASME BPVC Section VIII, Div. 1, UG-100 (flanged thermowells)

Sampling is not permitted.

3.16.4.9 Testing and Inspection Requirements for the **Gaskets** to be performed by the Completion Supplier

All testing and inspections shall be performed, as detailed below, to verify compliance with purchasing documents and ASME B31.3, B16.20, or ASME Section VIII, as applicable.

INSPECTION REQUIREMENT

Visual Inspection

Inspect the gaskets (for configuration and appearance) and related Completion Supplier documentation for any damage and for compliance with the purchasing documents. For all spiral wound gaskets, verify markings are per ASME B16.20.

Sampling is not permitted.

Dimensional Inspection

Measure the inside and outside diameters of the round gaskets and the thickness and gasket width of the rectangular gaskets to verify conformance the purchasing documents.

Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan. In this instance a lot is defined as all gaskets purchased on a single line item of the PO.

TESTING REQUIREMENT

Pressure Boundary Integrity Testing/Verification

Perform pressure test and leak detection test on "Q" items with associated gaskets per ASME B31.3, Section 345.8 or ASME Section VIII, UG-100, as applicable.

Sampling is not permitted. Testing of gaskets will occur at every joint. Additional gaskets that are purchased as spares or for replacement of test gaskets at final assembly are not required to undergo testing.

NOTE: Additional gaskets shall be procured as necessary to accommodate pressure testing. The test gaskets shall be identical (purchased on the same line item of the PO) to those that will be used in the final skid to be delivered to the WTP.

3.16.4.10 Testing and Inspection Requirements for **Flowmeters** to be performed by the Completion Supplier

All testing and inspections shall be performed to verify compliance with ASTM A182, ASTM A240, ASTM A312, and ASME B31.3, as applicable.

INSPECTION REQUIREMENTS

Visual Inspection - Material Markings/Identification

Inspect each flowmeter to confirm that the marking/identification is in accordance with the drawing, is clearly readable, and has no indication of re-marking by other parties.

Sampling is not permitted.

TESTING REQUIREMENTS

Chemical Composition Testing/Verification

Perform PMI on all flowmeter pressure boundary piping, and flanges.

Sampling is not permitted.

Pressure Boundary Integrity Testing/Verification

Perform pressure test, the performance of this test will use the system design pressure, no less than 1.5 times the system design pressure for hydrostatic test, or 1.1 times the system design pressure for pneumatic test, according to the location of the item tested.

Sampling is not permitted.

3.16.4.11 Testing and Inspection Requirements for the **Fasteners** to be performed by the Completion Supplier

All testing and inspections shall be performed, as detailed below, to verify compliance with purchasing documents, ASME/ASTM SA/A193, SA/A194, ASTM A490, A563, F436, ASME B18.2.1, B18.2.2, and B18.21.1, as applicable.

NOTE: This section does not cover fasteners that are supplied with separately purchased items (valve, strainer, etc.).

For sampling washers, a "lot" shall be defined as all items purchased under a single line item of the purchase order

INSPECTION REQUIREMENT

Visual Inspection

Inspect the fasteners to verify compliance with the purchasing documents and to ensure that markings are as specified in the applicable ASTM specification.

Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan.

Dimensional Inspection

Measure the following dimensions for compliance with the purchase order requirements and the applicable ASTM and ASME specification

Bolts/Studs - Nominal Diameter

Threads (2A)

Nuts - Thickness

Threads (2B)

Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan.

Washers - Inner Diameter (all types)

- Side length (beveled washers)

Reduced sampling plan per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan.

TESTING REQUIREMENT

Chemical Composition Testing/Verification

Perform PMI on stainless steel bolts, studs and nuts. (ASTMA490 bolts and studs and corresponding ASTM A563 nuts do not require PMI)

Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan.

For 347 material grade stainless steel fasteners use Destructive sampling per EPRI TR-017218 Table 2-2 Recommended Destructive Test, and Inspection Sampling Plan.

Hardness/Tensile/Proof Load Testing

Perform hardness testing on the bolts, studs, and nuts to ensure conformance with the applicable ASTM/ASME specifications and grade:

Hardness testing of 300 series SS bolts/studs without an identified ASTM or ASME specification shall meet the following criteria:

Diameter > ¾": Rockwell "B" 96 max

Diameter <= ¾": Rockwell "B" 100 max

For hardness testing sample per EPRI TR-017218 Table 2-2, Recommended Destructive Test, and Inspection Sampling Plan

Tensile testing may be used in lieu of hardness testing. For tensile testing sample per EPRI TR-017218 Table 2-2, Recommended Destructive Test, and Inspection Sampling Plan

Proof load testing may be used in lieu of hardness testing. Proof load testing is a non-destructive test for nuts, sample according to Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan.

3.16.4.12 Testing and Inspection Requirements for **Globe Control Valves** to be performed by the Completion Supplier

All testing and inspections shall be performed to verify compliance with ASTM A182, ASTM A351, ASME B31.3, ASME B16.34, and API 598, as applicable.

INSPECTION REQUIREMENTS

Visual Inspection - Material Markings/Identification

Inspect each valve to confirm that the valve marking/identification is in accordance with applicable codes/standards, is clearly readable, and has no indication of re-marking by other parties.

Sampling is not permitted.

TESTING REQUIREMENTS

Chemical Composition Testing/Verification

Perform PMI on valve bodies, bonnets and flanged end connections (where not integral to the body).

Sampling is not permitted.

Pressure Boundary Integrity Testing/Verification

Perform shell pressure test per ASME B16.34, Section 7. The performance of this test will use the system design pressure in lieu of the 38 C (100 F) pressure rating. No less than 1.5 times the system design pressure for hydrostatic test, or 1.1 times the system design pressure for pneumatic test, according to the location of the item tested.

Sampling is not permitted.

3.16.4.13 Testing and Inspection Requirements for **Pressure Gauges** to be performed by the Completion Supplier

All testing and inspections shall be performed to verify conformance with ASME B31.3.

INSPECTION REQUIREMENTS

Visual Inspection - Material Markings/Identification

Inspect the gauges to confirm that the marking/identification is in accordance with purchasing documents, is clearly readable, and has no indication of re-marking by other parties.

Sampling is not permitted.

TESTING REQUIREMENTS

Pressure Boundary Integrity Testing/Verification

Perform pressure test, the performance of this test will use the system design pressure, no less than 1.5 times the system design pressure for hydrostatic test, or 1.1 times the system design pressure for pneumatic test, according to the location of the item tested.

Sampling is not permitted

3.16.4.14 Testing and Inspection Requirements for **Process Offgas Heaters** to be performed by the Completion Supplier

All testing and inspections shall be performed to verify compliance with ASME SA240, ASME SB515, SB163, SB751, and ASME B&PVC Section VIII-Div. 1, UG-100, as applicable.

INSPECTION REQUIREMENTS

Visual Inspection - Material Markings/Identification

Inspect the heater assembly components at raw material state prior to fabrication to confirm that the manufacturer's marking/identification and configuration is in accordance with purchasing documents and drawings and is clearly readable. (Components to be inspected are the flange plates, thermocouple tubing, and heater tubing)

Sampling is not permitted.

Dimensional Inspection

Measure the following dimensions for compliance with the approved drawings, governing codes/standards, and purchase order requirements –

Flange Plate Thickness –No Sampling Permitted

Flange Plate Width – No Sampling Permitted

Flange Plate Height – No Sampling Permitted

Tube Wall Thickness - Reduced sampling plan per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan.

TESTING REQUIREMENTS

Chemical Composition Testing/Verification

Perform PMI on the flange plate, filler material (pre-fab, if any), element tube, and thermocouple nipple.

Samples of the materials shall be cut from the original material at the heater supplier's facilities and delivered to the Completion Supplier for testing. Traceability shall be maintained from the parent material to the test pieces. This shall be accomplished by witnessing of the cutting and transfer of information by a representative of the Completion Supplier's quality staff.

One PMI test is to be performed per heat of material.

Pressure Boundary Integrity Testing/Verification

Perform pressure test on the heater per the purchasing document requirements.

Sampling is not permitted.

3.16.4.15 Testing and Inspection Requirements for **Expansion Joints** to be performed by the Completion Supplier

All testing and inspections shall be performed to verify compliance with ASME SA240, ASME SA182 A479, ASME B31.3, ASME B16.5, ASME B&PVC Section VIII-Div. 1, EJMA, and other PO requirements, as applicable.

INSPECTION REQUIREMENTS

Visual Inspection - Material Markings/Identification

Inspect the Expansion Joints materials in the raw material state prior to fabrication to confirm that the manufacturer's marking/identification is in accordance with purchasing documents and drawings and is clearly readable.

Sampling is not permitted.

Configuration Inspection

Visually inspect each expansion joint to verify the correct number and shape of the convolutions is as specified on the on the purchasing documents, datasheets, and applicable design drawings.

Sampling is not permitted.

Dimensional Inspections

Perform the following dimensional inspections

- Flange Dimensions
    - Rectangular Expansion Joint
        - Inside dimensions
        - Thickness

- Width
- Round Expansion Joints
  - Inside Diameter
  - Flange Thickness

Sampling is not permitted

- Bellow Material Thickness

Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan.

Chemical Composition Testing/Verification

Perform PMI on flanges, bellows material (pressure retaining) and the weld filler material.

Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan

Traceability must be maintained from the parent material. This shall be accomplished by a surveillance or on-site over sight performed by a representative of the Completion Supplier's quality staff.

Pressure Boundary Integrity Testing/Verification

Perform pressure test on all expansion joints per the requirements of the purchasing documents.

Sampling is not permitted.

Weld Integrity Verification

Perform Liquid Penetrant Examination on all pressure retaining welds to verify pressure boundary. (Pressure retaining welds are defined as the longitudinal bellows welds and the bellows to flange welds.)

Sampling is not permitted.

3.16.4.16 Testing and Inspection Requirements for **HEPA Filter Housing** to be performed by the Completion Supplier

All testing and inspections shall be performed to verify compliance with the material specification referenced in the purchase order and ASME AG-1-1997 with AG-1A-2000 Addenda, and ASME/ASTM A240, A312, A479, A182, and A276, as applicable.

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INSPECTION REQUIREMENTS

Visual Inspection - Material Markings/Identification

Inspect the housing to confirm that the marking/identification is in accordance with purchasing documents and is clearly readable.

Sampling is not permitted.

TESTING REQUIREMENTS

Chemical Composition Testing/Verification

PMI is required to be performed on the filter housing body, housing cover and any pipe and pipe fittings to verify conformance with the applicable codes/standards. PMI on the HEPA housing pressure boundary components was performed by the previous supplier. No

further PMI is required by the Completion Supplier as all of the previous results were given a BNI submittal code status 1.

Sampling is not permitted.

Pressure Boundary Integrity Testing/Verification

Perform pressure decay test(s) on the filter housing assembly per ASME AG-1, Article III-4200, Pressure Decay test.

Sampling is not permitted.

3.16.4.17 Deleted

3.16.4.18 Testing and Inspection Requirements for the **Structural and Pressure Boundary Steel** to be performed by the Completion Supplier

All testing and inspections shall be performed, as detailed below, to verify compliance with purchasing documents, ASTM A240, A276, A554, A312, ASME BPV Code Section VIII Division 1, and Section V Article 10.

INSPECTION REQUIREMENT

Visual Inspection

Inspect the pressure boundary and structural steel to confirm that the marking/identification is in accordance with purchasing documents, is clearly readable, and has no indication of re-marking by other parties. Where stainless steel is remarked see "Chemical Composition Comparator test" section below, for carbon steel remarking treat each remarked piece as one lot and perform required testing per lot.

There may be instance where remarking does occur, e.g. only a portion of the complete piece of material is purchased, in which case additional testing is necessary to establish traceability. See "Chemical Composition Comparator Test" section below.

Sampling is not permitted.

Dimensional Inspection

Measure the following dimensions for compliance with the purchase order requirements and the applicable ASTM specification -

Plate and Sheet -	Thickness
Angle -	
	Leg Height
	Width
Structural Tube -	Wall Thickness
	Width
Flat Bar -	Width
	Thickness
Round Bar -	Diameter

Tightened sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test and Inspection Sampling Plan. Accept on 0 defects and reject on 1 or more defects.

TESTING REQUIREMENT

Chemical Composition Testing/Verification

Perform PMI on pressure boundary and structural stainless steel.

Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan.

Chemical Composition Comparator Test

Perform additional PMI at the time of receipt on materials that have been remarked.

In addition to the chemical composition test that is required on all received materials (normal sampling plan), PMI is required of all other sub-supplier remarked and untested pieces in a lot. For this comparator test either XFR or OES PMI may be used. For each heat of material the results of the comparator and chemical composition test shall meet the ASTM/ ASME standard, taking into account the margin of error of the PMI gun used.

Pressure Boundary **and Structural** Integrity Testing/Verification

Perform tensile/yield/elongation testing on the pressure boundary and structural carbon and stainless steel.

Sample per EPRI TR-017218 Table 2-2, Recommended Destructive Test and Inspection Sampling Plan.

3.16.4.19 Testing and Inspection Requirements for **Weld Filler Material** to be performed by the Completion Supplier

All testing and inspections shall be performed, as detailed below, to verify compliance with AWS/ASME A/SFA 5.9, A/SFA 5.14, A/SFA 5.18, A/SFA 5.20, and A/SFA 5.22, as applicable.

INSPECTION REQUIREMENTS

Visual Inspection

Inspect each container/spool of weld filler to confirm that the material marking/identification is in accordance with the applicable AWS specification, is clearly readable, and has no indication of re-marking by other parties.

Sampling is not permitted.

Dimensional Inspection

Measure the diameter of the weld filler metal for conformance with the applicable AWS/ASME specification.

Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan.

TESTING REQUIREMENTS

Chemical Composition Testing/Verification

Perform PMI on all the weld wire per applicable AWS/ASME standard.

Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan.

3.16.4.20 Testing and Inspection Requirements for **Fan Boots** to be performed by the Completion Supplier

All inspections shall be performed, as detailed below, to verify compliance with all applicable purchase order requirements.

INSPECTION REQUIREMENTS

Visual Inspection

Visually inspect each fan boot to verify configuration and marking conformance to the PO requirements including drawings and datasheets.

Sampling is not permitted.

Visual Inspection of Bellows Material

Visually inspect bellows material shows no indication of delamination, tears or compression set.

Sampling is not permitted

Dimensional Inspection

Measure the end to end of the fan boot for conformance with PO requirements.

Sampling is not permitted.

Pressure Boundary Integrity Testing/Verification

Perform pressure test, the performance of this test will use the system design pressure, no less than 1.1 times the system design pressure for pneumatic test, according to the location of the item tested.

Sampling is not permitted.

3.16.4.21 Testing and Inspection Requirements for **Instrument Tubing, Valves, and Fittings** to be performed by the Completion Supplier

All testing and inspections shall be performed to verify compliance with ASME SA240, ASME SA182, ASME B31.3, ASME B16.5, ASME B&PVC Section VIII-Div. 1, and other PO requirements, as applicable.

INSPECTION REQUIREMENTS

Visual Inspection

Inspect each item to confirm that the material marking/identification is in accordance with the applicable ASTM/ASME specification, is clearly readable, and has no indication of re-marking by other parties.

Sampling is not permitted.

Dimensional Inspection

Perform dimensional inspection of the instrument tubing and fittings that are to be used in production as follows:

Tube - Wall thickness at each end

Tube Fittings- End to End and / or End to Centerline

Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan.

TESTING REQUIREMENTS

Chemical Composition Testing/Verification

Perform PMI on the tubing.

Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan.

Pressure Boundary Integrity Testing/Verification

Perform pressure test for installed items per the functional test or shop inspection test plan.

Sampling is not permitted.

3.16.4.22 Testing and Inspection Requirements for **Insulating Pads** to be performed by the Completion Supplier

All testing and inspections shall be performed, as detailed below, to verify compliance with all applicable purchase order requirements.

INSPECTION REQUIREMENTS

Visual Inspection

Visually inspect each insulating pad to verify configuration and marking conformance to the PO requirements including drawings and datasheets.

Sampling is not permitted.

Dimensional Inspection

Measure the length, width, and thickness of each insulating pad to ensure conformance with PO requirements.

Sampling is not permitted.

TESTING REQUIREMENTS

Compression Testing/Verification

Perform Compression tests per IONEX test procedure, test to verify 1.5 x minimum 1300 psi. Compression test according to lot defined by all line items in a single PO from a single manufacturer.

Destructive sampling per EPRI TR-017218 Table 2-2 Recommended Destructive Test, and Inspection Sampling Plan on per lot basis as defined above.

3.16.4.23 Testing and Inspection Requirements for **Strut Mounts, Clamps, and Nuts** to be performed by the Completion Supplier

All testing and inspections shall be performed, as detailed below, to verify compliance with all applicable purchase order requirements.

INSPECTION REQUIREMENTS

Visual Inspection
Visually inspect each clamp, mount and channel nut to verify configuration and marking conformance to the PO requirements including drawings and datasheets.

Sampling is not permitted.

Dimensional Inspection

Perform dimensional inspection on the components as follows:

Strut Mounts –	Width
	Thickness
Clamps –	Width
	Thickness
Channel Nuts –	Thread Gauge (B for internal thread)

Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test, and Inspection Sampling Plan.

TESTING REQUIREMENTS

Chemical Composition Testing/Verification
Perform PMI on the following.
Clamps (exclude fasteners)
Strut mounts (excluding elastomer cushion)
Channel nuts (excluding spring)

Normal sampling per EPRI TR-017218 Table 2-1, Recommended Set of Nondestructive Test and Inspection Sampling Plan.

3.16.4.24 Testing and Inspection Requirements for **Pressure Transmitter** to be performed by the Completion Supplier

All testing and inspections shall be performed to verify conformance with ASME B31.3.

INSPECTION REQUIREMENTS

Visual Inspection - Material Markings/Identification

Inspect the pressure transmitter to confirm that the marking/identification is in accordance with purchasing documents, is clearly readable, and has no indication of re-marking by other parties.

Sampling is not permitted.

TESTING REQUIREMENTS

Chemical Composition Testing/Verification

Perform PMI on the process flanges and measuring cell body.

Sampling is not permitted.

Pressure Boundary Integrity Testing/Verification

Perform pressure test, the performance of this test will use the system design pressure, no less than 1.5 times the system design pressure for hydrostatic test, or 1.1 times the system design pressure for pneumatic test, according to the location of the item tested.

Sampling not permitted.

3.17 Engineering requirements for commercial components purchased from a sub supplier or commercial items provided by WTP for reuse.

3.17.1 The TCO skid and ammonia dilution skid are fabricated from raw materials and purchased components. Fabrication and testing the TCO and ammonia dilution skid from raw materials is well understood and adequately defined in this specification. The purchase of commercial components or reuse of commercial components provided by WTP for a Q application is a complex process and in some cases requires additional engineering controls above those established for CGD. Some commercial components with a quality level of Q or CM are manufactured using a special process (welding, heat treatment and NDE). WTP may define additional requirements for commercial items manufactured using a special process. Based on the components quality level and safety function, engineering will define in the sections below any additional requirements or define requirements that are not required for purchased or reused commercial components.

3.17.2 Round bellows for the TCO, LVP-BLWS-00053, LVP-BLWS-00061, LVP-BLWS-00080 and LVP-BLWS-00081.

The Quality level for the round bellows is Q. The safety function is confinement of offgas. Round bellows are commercial items for general industry use and are basically catalog items ready for installation from the manufacturer. The round bellows for the TCO will be manufactured using a special process (welding and nondestructive examination). Heat treatment is not required, as defined in Section 3.1.12.

- The Completion Supplier / bellows manufacturer shall submit outline drawings with welding and NDE defined on the drawings.
- The Completion Supplier/ bellows manufacturer shall submit weld procedures for review.
- The Completion Supplier / bellows manufacturer shall have welder qualifications on file for review by the WTP supplier Quality representative.
- The Completion Supplier / bellows manufacturer shall submit NDE procedures for review.
- The Completion Supplier / bellows manufacturer shall submit test procedure(s) for review.
- The Completion Supplier / bellows manufacture is not required to minimize halide or chloride exposure during the manufacturing process or shipping. If the bellows manufacturer has a practice in place for minimizing halide and chlorides it may be used. Submittal of halide / chloride control program is not required because the LAW Offgas contain chlorides.
- The Completion Supplier / bellows manufacture shall notify WTP Supplier Quality Representative in advance for witnessing the first operation basis for each reviewed weld

procedure and NDE procedure. It is acceptable for WTP SQR to witness welding and NDE of similar production items.
• The WTP supplier Quality Representative will witness testing performed for each test procedure.

3.17.3 Thermowells for the TCO, TW 0507, 0508, 0511, 0513, 0517, 0519, & 0524.

The Quality level for the thermowells is Q. The safety function is confinement of offgas. Thermowells are commercial items for general industry use and are basically catalog items ready for installation from the manufacturer.

- The Completion Supplier / thermowell manufacturer shall submit outline drawings.
- The Completion Supplier / thermowell manufacture is not required to minimize halide or chloride exposure during the manufacturing process or shipping. If the thermowell manufacturer has a practice in place for minimizing halide and chlorides it may be used. Submittal of halide / chloride control program is not required because the LAW Offgas contain chlorides.

3.17.4 Recuperative heat exchanger, LVP-HX-00001, (non Pressure boundary welding, NDE) Commercial Material (CM), enclosed in a Q confinement enclosure.

The recuperative heat exchanger with inlet and outlet bellows are commercial items for general industry use. The recuperative heat exchanger with inlet and out bellows will be manufactured using a special processes (welding, (heat treatment if required) and nondestructive examination (NDE)).

- The Completion Supplier / recuperative heat exchanger manufacture shall submit outline drawings with welding and NDE defined on the drawings.
- The Completion Supplier / recuperative heat exchanger manufacturer shall submit weld procedures for review. Include weld procedure(s) for bellows fabrication.
- The Completion Supplier / recuperative heat exchanger manufacturer shall have welder qualifications on file for review by the WTP supplier Quality representative (SQR).
- The Completion Supplier / recuperative heat exchanger manufacturer shall submit NDE procedures for review.
- The Completion Supplier / recuperative heat exchanger manufacturer shall submit heat treat procedures for review (if used).
- The Completion Supplier / recuperative heat exchanger manufacturer shall submit test procedure(s) for review.
- The Completion Supplier / recuperative heat exchanger manufacturer is not required to minimize halide or chloride exposure during the manufacturing and shipping process. If the recuperative heat exchanger / bellows manufacturer has a practice in place for minimizing halide and chlorides it may be used. Submittal of halide / chloride control program is not required. The process flowing through the recuperative heat exchanger will include chlorides.
- The Completion Supplier / recuperative heat exchanger manufacturer shall notify WTP Supplier Quality Representative in advance for witnessing the first operation basis for each reviewed weld procedure, heat treat procedure (if used) and non destructive examination (NDE) procedure. It is acceptable for WTP SQR to witness welding, heat treatment and NDE of similar production items.
- The Completion Supplier / recuperative heat exchanger manufacturer shall notify WTP Supplier Quality Representative in advance for witnessing the first operation basis for pressure testing.

3.17.5 Rectangular bellows for the TCO, LVP-BLWS-00055, 00056, & 00058.

The Quality level for the rectangular bellows is Q. The safety function is confinement of offgas. Rectangular bellows are commercial items for general industry use and are basically catalog items ready for installation from the manufacturer. The rectangular bellows for the TCO will be manufactured using special processes (welding and nondestructive examination). Heat treatment is not required, as defined in Section 3.1.12.

- The Completion Supplier / bellows manufacturer shall submit outline drawings with welding and NDE defined on the drawings.
- The Completion Supplier / bellows manufacturer shall submit weld procedures for review.
- The Completion Supplier / bellows manufacturer shall have welder qualifications on file for review by the WTP supplier Quality representative.
- The Completion Supplier / bellows manufacturer shall submit NDE procedures for review.
- The Completion Supplier / bellows manufacturer shall submit test procedure(s) for review.
- The Completion Supplier / bellows manufacturer is not required to minimize halide or chloride exposure during the manufacturing and shipping process. If the bellows manufacturer has a practice in place for minimizing halide and chlorides it may be used. Submittal of halide / chloride control program is not required because the LAW Offgas contains chlorides.
- The Completion Supplier / bellows manufacturer shall notify WTP Supplier Quality Representative in advance for witnessing the first operation basis for each reviewed weld procedure. It is acceptable for WTP SQR to witness welding of similar production items.
- The WTP supplier Quality Representative will witness testing performed for each test procedure.

3.17.6 Process heaters LVP-HTR-00002A, B, C, D & E

The Quality level for the process heaters is Q. The safety function is confinement of offgas. Process heaters are commercial items for general industry use and are basically catalog items ready for installation from the manufacturer. The process heaters for the TCO will be manufactured using special processes (welding and nondestructive examination).

- The Completion Supplier / process heater manufacturer shall submit outline drawings with welding and NDE defined on the drawings.
- The Completion Supplier / process heater manufacturer shall submit weld procedures for review.
- The Completion Supplier / process heater manufacturer shall have welder qualifications on file for review by the WTP supplier Quality representative.
- The Completion Supplier / process heater manufacturer shall submit NDE procedures for review.
- The Completion Supplier / process heater manufacturer shall submit test procedure(s) for review.
- The Completion Supplier / process heater manufacturer is not required to minimize halide or chloride exposure during the manufacturing and shipping process. If the process heater manufacturer has a practice in place for minimizing halide and chlorides it may be used. Submittal of halide / chloride control program is not required because the LAW Offgas contains chlorides.
- The Completion Supplier / process heater manufacturer shall notify WTP Supplier Quality Representative in advance for witnessing the first operation basis for each reviewed weld procedure. It is acceptable for WTP SQR to witness welding of similar production items.
- The WTP supplier Quality Representative will witness testing performed for each test procedure.

3.17.7 Flanged ball valves for the TCO, LVP-V-01547, 01548, 01609, 01610, 01611, 01612, 01613, 01614, 01615, 01616, 01617, 01618, 01619, 01620, 72263, 72264, 72265, 72266, 72267, 72334 and 72335.

The Quality level for the flanged ball valves is Q. The safety function is confinement of offgas. Flanged ball valves are commercial items for general industry use and are basically catalog items ready for installation from the manufacturer. The requirements specified under section 3.16.4.5 are adequate for the flanged ball valves. Additional engineering requirements are not required.

- The Completion Supplier / ball valve manufacturer is not required to minimize halide or chloride exposure during the manufacturing and shipping process. If the ball valve manufacturer has a practice in place for minimizing halide and chlorides it may be used. Submittal of halide / chloride control program is not required because the LAW Offgas contains chlorides.

3.17.8 LVP-SCO-00001 and SCR-00001 catalyst sheet metal enclosures

The Quality level for the catalyst sheet metal enclosures is CM. The catalyst sheet metal enclosures do not have a safety function. The catalyst sheet metal enclosures are commercial items for general industry use and are catalog items ready for installation from the manufacturer. The catalyst sheet metal enclosures are manufactured using a special process (welding), based on the quality level and safety function additional engineering requirements are not required.

- The Completion Supplier / catalyst sheet metal enclosure manufacturer is not required to minimize halide or chloride exposure during the manufacturing process. Submittal of halide / chloride control program is not required because the LAW Offgas contains chlorides.

3.17.9 Deleted

3.17.10 Pipe and tubing for the TCO and ammonia dilution skid, production made, seamless or welded.

The Quality level for the pipe and tube is Q. The safety function is confinement of offgas, ammonia, C3 air and instrument air. Pipe and tubing are commercial items for general industry use and are basically catalog items ready for installation from the manufacturer. Welded pipe and tube is manufactured using a special process (welding and nondestructive examination). The requirements specified under section 3.16.4.2 are adequate. Additional engineering requirements are not required for pipe and tube.

- The Completion Supplier / pipe or tube supplier is not required to minimize halide or chloride exposure during the manufacturing or shipping. Submittal of halide / chloride control program is not required.

3.17.11 Junction boxes LVP-JB-00012, JB-0027 and / Control panel LVP-PNL-00003

The Quality level for junction boxes and the control panel is CM. The junction boxes and the control panel have no safety function. The junction boxes and control panel are commercial items for general industry use and are catalog items ready for installation from the manufacturer. Junction boxes and control panels are manufactured using a special process (welding). Based on the quality level and safety function additional engineering requirements are not required.

- The Completion Supplier / junction box control panel supplier is not required to minimize halide or chloride exposure during the manufacturing or shipping. Submittal of halide / chloride control program is not required.

3.17.12 Ammonia Dilution air fans, LVP-FAN-00001 and LVP-FAN-00002.

The Quality level for the fans on the ammonia dilution skid is Q for air permit. The fans do not have a safety function. Fan manufacturers produce commercial items for general industry use. These fans are basically catalog items ready for installation from the manufacturer. The fans are manufactured using a special process (welding and nondestructive examination). A standard fan from a manufacturer is acceptable for this application. The Completion Supplier will perform additional tests and inspections as defined in section 3.16.4.3 as part of the CGD process after the fans arrive at the Completion Suppliers shop. The tests below are designed to minimize quality risk and provide reasonable assurance that the product specified will perform as intended.

- The Completion Supplier / fan manufacturer shall submit outline drawings for installation and maintenance. Detailed fabrication drawings with weld symbols, are not required.
- Controls to minimize halide or chloride exposure during manufacture and shipping are not required. This fan is exposed to air and not subject to stress corrosion cracking, where halide / chloride control is important.
- The Completion Supplier / fan manufacturer weld procedures are not required for review.
- The Completion Supplier shall submit fan pressure test procedure(s) for review.
- The Completion Supplier / fan manufacturer shall submit technical data sheets for the coating, MSDS and fill out Appendix H, "Manufacturers standard coating data sheet".

The fan manufacturer shall perform a pressure test on the fans prior to shipping. It is preferred that the fan pressure test be performed before any coating system is applied. Since this fan may be made from coated parts already in inventory, the pressure test maybe performed after coating. The fan manufacturer shall perform a bubble test when the fan is not operating. The Completion Supplier Quality Representative will witness pressure testing. The acceptance criteria shall be no bubble growth in the area being inspected (flanged joints, gasket joints, mechanical seal tubing / piping). The object of the test is to confirm that the fan will hold pressure before the fan is shipped. This pressure test is required by engineering to minimize commercial risk.

3.17.13 Manual valves, control valves, strainer, pressure control valve, pressure gauges, pressure indicating transmitters, HEPA housings, flow meters and thermowells on the ammonia dilution skid supplied by the Completion Supplier or reused by WTP.

The Quality level for these items is Q. These items are commercial items for general industry use and are basically catalog items ready for installation from the manufacturer. The requirements specified under section 3.16 are adequate for these items. Additional engineering requirements are not required for these items on the ammonia dilution skid.

- The Completion Supplier / manufacturer / supplier are not required to minimize halide or chloride exposure during the manufacturing or shipping. Submittal of halide / chloride control program is not required.

3.17.14 Insulation stud material

- The Completion Supplier weld program has been surveyed and found acceptable.
- The Completion Supplier shall use a stud weld procedure with a status determined by WTP.
- The Completion Supplier shall check that stainless steel insulation studs are Nonmagnetic with a magnet. Nonmagnetic insulation studs are acceptable for use.

4 Materials

4.1 General

4.1.1 The Completion Supplier shall comply with specification 24590-WTP-3PS-G000-T0002, *Engineering Specification for Positive Material Identification (PMI) for Shop Fabrication.*

4.2 Construction

4.2.1 Materials of construction shall have properties suitable for the service conditions defined in the MDSs.

4.2.2 The ASME and/or ASTM material numbers and grades shall be identified and MTRs showing actual test report values shall be provided for the housing, ducts, weld filler metal, and support framing integral to the Thermal Catalytic Oxidizer/Reducer and the associated Ammonia/Air Dilution assemblies. Material designations shall be indicated on the fabrication drawings and in the material lists.

4.2.3 Thermal Catalytic Oxidizer/Reducer and the associated Ammonia/Air Dilution skids shall be fabricated from structural steel shapes and plates properly reinforced to be self-supporting, capable of carrying the static loads of components and the stresses imposed during shipment, installation, and operation.

4.2.4 Thermal Catalytic Oxidizer/Reducer and the associated Ammonia/Air Dilution housings and outlet piping shall be fabricated from materials specified in the MDSs in Section 2 of the MR. Structural supports in contact with the offgas stream shall be constructed from the same material as the high temperature surfaces as specified on the MDS in Section 2 of the MR.

4.2.5 Where the Buyer has not specified material types, the Completion Supplier shall select materials giving consideration to the design life of the equipment, compatibility with adjacent materials, compatibility with the process materials and conditions, environmental conditions, and coating requirements. The Buyer shall review and approve materials selected by the Completion Supplier.

4.2.6 CMTRs, MTRs, C of Cs, etc. Are not required for non-permanent plant equipment.

4.3 Prohibited Materials

4.3.1 As applicable, mercury, zinc, cadmium, or other low melting point materials and halogens shall not be used in direct contact with stainless steel. This prohibition also applies to use of tools, fixtures, paints, coatings and sealing compounds, and any other equipment or materials used by the Completion Supplier in handling, assembly and storage of stainless steel parts or components. Except as excluded in section 3.17.

4.3.2 Asbestos shall not be used in any component of the Thermal Catalytic Oxidizer/Reducer, the associated Ammonia/Air Dilution units, and appurtenances.

4.3.3 The prohibited materials list excludes materials that might be used for bearings, brazed joints, or instruments.

4.3.4 The equipment provided to the Buyer shall not contain any of the materials listed in 24590-WTP-LIST-CON-08-0001, *Restricted Materials List WTP Safety Assurance* unless BUYER (Safety Assurance) approval is obtained.

4.4 Insulation

4.4.1 The Completion Supplier shall provide detailed insulation installation procedures for removable insulation only.

4.4.2 The Completion Supplier shall recommend cements, mastics, and adhesives that will be suitable for the maximum design temperature of the Thermal Catalytic Oxidizer/Reducer. The mixing of cements, mastics, etc., shall be done with deionized water.

4.4.3 Provide removable / reusable insulation for the TCO inlet and outlet bellows (LVP-BLWS-00053 and 00051), and rectangular / round expansion joints.

4.4.4 Insulation thickness greater than three (3) inches applied to the exterior of the Thermal Catalytic Oxidizer/Reducer shall be applied in multiple layers with staggered joints. Each layer of multiple layer and double insulation shall be held in place separately.

4.4.5 Exterior insulation shall be jacketed with 304 stainless steel. The stainless steel jacketing shall be 0.024 inch thick flat and smooth sheet, and conform to ASTM A240. The jacketing shall be furnished in the annealed or soft condition with a regular 2B mill finish and have a factory applied moisture barrier.

4.4.6 Design jacketing with an overlap of 2 inch minimum between sections. Standard process industry practices shall be followed.

4.4.7 The TCO insulation shall be designed to prevent the ingress of water during the 2.0 hour fire water spray. The fire water spray is expected to occur once during the 40 year life of the plant. The design of the jacketing shall be such that the joints shed water. Process Industry Practices, PIP INIH1000, Hot Insulation Installation Details, provide generic details for weatherproof jacketing.

4.4.8 All insulation components, including facings, mastics, and adhesives, shall meet ASTM E84 fire hazard rating not to exceed 25 for flame spread and 50 for fuel contributed and smoke developed. Ratings used are determined by Underwriters Laboratories Inc. (UL).

4.4.9 Submit welding procedures for any insulation tabs or studs that are welded to the pressure boundary, as required.

4.5 Government Material

If the Completion Supplier so chooses, the Buyer shall supply, as Government Furnished Equipment (GFE), miscellaneous parts, and a certified bulk quantity of 347 stainless steel. See Section 4b, Special Conditions of the PO.

5 Fabrication

5.1 General

5.1.1 Fabrication of the thermal catalytic oxidizer/reducer units shall be in accordance with the requirements of 24590-WTP-3PS-MV00-T0001, *Engineering Specification for Pressure Vessel Design and Fabrication.*

5.1.2 Fabrication of piping shall meet the requirements of the Buyer specification 24590-WTP-3PS-NWP0-T0001 *Engineering Specification for General and NDE Requirements for Supplier Fabricated Piping*, Attachment PS02 *Engineering Specification for Shop Fabrication of Piping*, and ASME B31.3.

5.1.3 All stainless steel metal working, grinding, cutting, machining and welding shall use tools and consumables dedicated and segregated from all others to prevent cross contamination. A dedicated work area for tools, equipment storage, parts storage and raw materials must be established to control contamination. Welding consumables for stainless steel welding must be segregated from other consumables.

5.1.4 Ammonia gas pipe line connections

- To minimize ammonia gas leaks inside the LAW facility, socket weld and or butt weld fittings and components are preferred, followed by flanged connections. Hy-Lok valves and tubing are acceptable for instrument connections. Threaded connections 1/2 inch and smaller are acceptable, but should be minimized.
- Thread Sealant Tape- Anti-Seize technology, Inc., Item Number 46230, POLYTEMP HD Extra Heavy Duty PTFE tape or engineering approved equal, 1/2 inch wide, 0.0032 inches thick, density 1.2 - 1.5 g/cc, MIL-T-27730A.

5.2 Welding

5.2.1 Design and fabrication of the TCO pressure boundary shall be in accordance with specification 24590-WTP-3PS-MV00-T0001, *Engineering Specification for Pressure Vessel Design and Fabrication*

5.2.2 Welding of the TCO pressure boundary shall be in accordance with specification 24590-WTP-3PS-MVB2-T0001, *Engineering Specification for Welding of Pressure Vessels, Heat Exchangers and Boilers.*

5.2.3 Fabrication of TCO piping shall be in accordance with Attachment PS02 *Engineering Specification for Shop Fabrication of Piping.*

5.2.4 Welding and NDE of TCO piping shall be in accordance with specification 24590-WTP-3PS-NWP0-T0001, *Engineering Specification for General Welding and NDE Requirements for Supplier Fabricated Piping.*

5.2.5 Welding of carbon structural steel shall be in accordance with AWS D1.1 and specification 24590-WTP-3PS-SS00-T0001, *Engineering Specification for Welding of Structural Carbon Steel.*

5.2.6 Welding of structural stainless steel shall be in accordance with AWS D1.6 and BUYER specification 24590-WTP-3PS-SS00-T0002, *Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel.*

5.3 Coating

5.3.1 Shop coating shall be in accordance with Attachment AFPS *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment,* Appendix D, Number 8.20, System Code D.

5.3.2 A manufacturer's coating data sheet (see Attachment AFPS *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment*, Section 6.2.1.2) is required for each commercial off the shelf (COTS) item or component that is supplied with a manufacturer's standard coating.

5.3.3 The top coat shall be ANSI 70 grey in color.

5.3.4 Attachment AFPS *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment*, does not apply to non-permanent plant equipment.

5.4 Assembly

5.4.1 The Thermal Catalytic Oxidizer/Reducer and the associated Ammonia/Air Dilution unit shall have edges that are both smooth and not sharp to the touch.

6 Tests and Inspections

6.1 General

6.1.1 The Completion Supplier shall provide all instruments, cables, and facilities necessary to perform any shop tests, the Functional Tests (FT) and NDE.

6.1.2 In addition to the pressure tests required by the Boiler and Pressure Vessel Code and piping code, the Completion Supplier shall functionally test the TCO. The Completion Supplier shall provide test hardware. Test hardware is expected to include, but is not limited to: fan/exhauster/ blower, pre heater, piping, ducting, instrument tubing, power, controls and temporary insulation. The functional test shall include a fan/exhauster/blower that provides enough flow to bring the TCO up to or near the design temperature (without damage to the heating elements due to low flow). The functional test flow rate is expected to be between (2,000 scfm and 3,000 scfm). During the functional test the TCO will be brought up to temperatures that approach the operating temperature of the unit. The expected test temperature measured after heater LVP-HTR-00002 will be in the range of 600 to 700 F. This temperature range is subject to change as test details are developed. Air will be used during the test, no chemicals or test gases will be injected into the gas stream. The SCO and SCR catalyst modules will be installed during the test. The major test objectives are: verify heater operation using control panel LVP-PNL-00003, after unit cool down verify the SCO and SCR catalyst modules can be removed and reinstalled. Verify by visual observation the catalyst racks and catalyst gaskets are not distorted after being subjected to elevated temperatures.

6.1.3 In addition to the pressure tests required by the piping code, the Completion Supplier shall functionally test the LAW ammonia / air dilution skid. The Completion Supplier shall provide the necessary test hardware to run the ammonia /air dilution fans LVP-FAN-00001and 00002 on skid LVP-SKID-00003. Test hardware is expected to include, but is not limited to: a compressed air source, instrument tubing, power and controls. The Ammonia /air dilution skid does not have to be connected to the TCO for the functional testing. Ammonia gas will not be required for testing. Air at 15 psig will be used to simulate the ammonia gas during testing. The major test objectives are: verify fan operation and control using panel LVP-PNL-00003, verify valves open and close, verify flow meter operation.

6.1.4 The following section only applies to rectangular flanges or proto type testing. The LAW TCO is located in the offgas system near the LAW exhausters that generate the entire system vacuum. The LAW TCO rectangular flanges are normally under fairly high negative pressure and high operating temperatures. Rectangular flanges that allow excess air to leak into the offgas system during normal operations are not acceptable. The Completion Supplier shall test a mockup of the rectangular flange design to prove the design works at ambient temperature. Holding pressure at ambient temperature provides confidence that the flange design will perform as designed at elevated temperatures and pressure. The rectangular flange design shall be proved by testing as early as possible to minimize schedule delays.

The Completion Supplier shall select the appropriate test or tests. For example; a Bubble Test in accordance with ASME B & PVC, Section V, Article 10, Appendix I- Bubble Test, may be conducted at 2 psi to check for gross leaks. The bubble test could be followed by a negative pressure test. These tests shall be performed well ahead of the Functional Test (FT) to be of any benefit to the project. A complete mock up test assemble can be fabricated from new material or GFE material available for this fabrication. The objective of this test is to confirm the flange design including fasteners and gaskets will perform as designed at system negative pressure with some margin.

The flange / proto type test(s) are designed to confirm the flange design and mitigate risk. Submittal of test procedures for this section is optional, since similar test procedures will be submitted when the FT is conducted.

6.2 Personnel Qualifications

NDE personnel performing NDE shall work in accordance with the following the Buyer specifications:

- 24590-WTP-3PS-MV00-T0001, *Engineering Specification for Pressure Vessel Design and Fabrication*
- 24590-WTP-3PS-MVB2-T0001, *Engineering Specification for Welding of Pressure Vessels, Heat Exchangers and Boilers*
- 24590-WTP-3PS-SS00-T0001, *Engineering Specification for Welding of Structural Carbon Steel*
- 24590-WTP-3PS-SS00-T0002, *Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel*
- 24590-WTP-3PS-NWP0-T0001, *Engineering Specification for General Welding and NDE Requirements for Supplier Fabricated Piping*
- Attachment PS02 *Shop Fabrication of Piping*

6.3 Non-Destructive Examinations

6.3.1 NDE shall be performed in accordance with the following the Buyer specifications:

- 24590-WTP-3PS-MV00-T0001, *Engineering Specification for Pressure Vessel Design and Fabrication*
- 24590-WTP-3PS-MVB2-T0001, *Engineering Specification for Welding of Pressure Vessels, Heat Exchangers and Boilers*
- 24590-WTP-3PS-SS00-T0001, *Engineering Specification for the Welding of Structural Carbon Steel*
- 24590-WTP-3PS-SS00-T0002, *Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel*
- 24590-WTP-3PS-NWP0-T0001, *Engineering Specification for General Welding and NDE Requirements for Supplier Fabricated Piping*
- Attachment PS02 *Shop Fabrication of Piping*

6.3.2 NDE procedures shall be submitted to the Buyer for review and approval prior to use.

6.3.3 Submittal of exposed radiographs is required. Original set of exposed radiographic film must be sent, along with technique and reader sheets. Film must be packaged in such a manner as to preclude moisture and handling damage.

6.4 Shop Tests

6.4.1 Pre-Functional Test

6.4.1.1 The Completion Supplier shall perform instrument testing, inspection and calibration required to verify compliance with this specification. When requested, procedures and reports provided for records shall be submitted for the Buyer's review in accordance with Part 2 of the material requisition, Forms G321-E of the material requisition to which this specification is attached.

6.4.1.2 The Buyer's Supplier Quality (SQ) and an engineering representative shall witness the Completion Supplier's functional tests.

6.4.2 Instrumentation and controls that contain solid state components shall be subjected to burn-in as required. Burn-in duration shall be 72 hours minimum. The Completion Supplier shall provide the Buyer with 10 business day's notification to allow the Buyer to witness the test.

6.4.3 All wiring provided by the Completion Supplier shall be verified 100% with a point to point continuity test. Wiring errors that are detected shall be corrected, including drawings, prior to the Buyer's inspection.

6.4.4 Software functional testing shall be governed by 24590-WTP-3PS-JQ00-T0004, *Engineering Specification for Management of Supplier Software.*

6.4.5 A simulated signal shall be injected and varied over the full range for each devise in the instrumentation and control circuits. Each device shall be calibrated and checked for correct operation by simulating inputs, actuating switches, and monitoring outputs, indicating lights, etc.

6.4.6 Failure to perform such tests or failure of any part shall be cause for rejection of part or all of the system components.

6.4.7 The Completion Supplier's shop tests shall include the following:

a. Megger test before termination of all 480V wiring pulled into conduit. See Part 2, Attachment SQ of the MR for Witness and Hold Points schedule. Record on the FT.

b. Continuity check of all wiring for conformance with drawings. See Part 2, Attachment SQ of the MR for Witness and Hold Points schedule. Record on the FT.

6.4.8 Prior to notification by the Completion Supplier that a unit is ready for the Buyer to witness the Functional Test portion of the FT, the Completion Supplier shall perform all other FT mechanical and electrical inspections to ensure completed equipment is functioning and ready for the Functional Test. See Part 2, Attachment SQ of the MR for Witness and Hold Points schedule.

6.4.9 The Completion Supplier shall have the unit up and ready for Functional Testing prior to the Buyer's team arriving.

6.4.10 The Completion Supplier shall submit the Functional Test Procedure for the Buyer to review prior to use by the supplier.

6.4.11 The Completion Supplier shall submit a report of the FT results.

6.4.12 The Functional Test Procedures shall be prepared by the Completion Supplier in accordance with Attachment JQ07, Section 11.3.2.

6.4.13 The following is a list of preliminary Buyer expectations for the TCO Functional Test. This list is subject to change during review of the proposed test procedure. All results shall be recorded on the FT datasheet.

a. The TCO is completely assembled for the following tests:

i. Pressure testing shall be performed in accordance with required testing specified in ASME B31.3-1996 or ASME Section VIII, Division 1, as applicable. In addition to these code required pressure tests, additional testing shall be performed to further demonstrate the pressure boundary integrity of the equipment.

ii. Sensitive Leak Testing shall be performed on piping in accordance with ASME B31.3, Section 345.8, as required.

iii. Bubble Testing shall be performed in accordance with ASME Section 5, Article 10, as required.

iv. Obtain unit pressure drop measurements at ambient conditions and at heat up intervals. Record on FT datasheet.

v. Deleted

vi. Preheat the incoming air prior to LVP-HTR-00002, to simulate the hot offgas from the melter, as required.

vii. Provide power and temporary controls for LVP-HTR-00002.

viii. Operate the TCO at test temperature for 24 hours. This time frame includes initial system heat up and time for the TCO to stabilize at operating temperature.

b. Test Objective

i. Verify the TCO heater, LVP-HTR-00002, provides the required heat to maintain temperature.

ii. Verify the JC 0510A loop controls LVP-HTR-00002 within the operating range.

iii. Verify the 2 Melter nominal flowrate of approximately 4702 ACFM (or as specified in the MDS) can be achieved. The flowrate provided here is for information only and subject to change. Refer to the MDS for the actual flowrate.

iv. Verify the actual differential pressure drop is less than the allowable differential pressure. Refer to the MDS for the actual pressure. Record on the FT datasheet.

v. Verify the TCO outlet temperature at TE-0524 is less than 486°F. The temperature provided here is for information and subject to change. Refer to the MDS for the actual temperature.

vi. Deleted

vii. Deleted

viii. Verify the unit pressure drop is within acceptable limits as stated in the Buyer approved FT. Record on the FT datasheet.

ix. Deleted

c. Deleted

d. After the TCO unit has cooled, verify no deformation or degradation to the housing and internal components has occurred.

e. Deleted

f. After the TCO has cooled, remove the SCO and SCR catalyst modules. Verify by visual observation if the catalyst racks and or catalyst gaskets have distorted during the functional test. Reinstall all of the catalyst to confirm the catalyst modules can be completely reloaded. If distortion was observed, repair / replace as required. If distortion was observed repeat the test after repairs / replacements are complete. Repeat test duration can be 8 hours or less. Record results on FT datasheet.

g. The Completion Supplier shall submit the catalyst installation and removal procedure.

h. Demonstrate heater removal and insertion. This step can be accomplished at any time, before or after the functional testing.

6.4.14 The following is a list of requirements for the Ammonia / Air Dilution Skid Functional Test. This test is subject to change by the Buyer during the review of the proposed test procedure. Changes to these expectations, agreed to during the review, do not need to be reflected in a revision to this specification. All results shall be recorded on the FT datasheet

a. The ammonia dilution skid is completely assembled. Control panel, LVP-PNL-00003 is complete and ready for testing.

i. Pressure testing shall be performed in accordance with the required testing specified in ASME B31.3. In addition to these code required pressure tests, additional testing shall be performed to further demonstrate the pressure boundary integrity of the equipment.

ii. Sensitive Leak Testing shall be performed on piping in accordance with ASME B31.3, Section 345.8, as required.

iii. It is acceptable to use temporary air and controls to open and close valves on the skid.

b. The Completion Supplier shall provide the following air source:

i. Not Used

ii. Dry, oil and dust free Instrument Service Air (ISA) at 90-150 psig and with a dew point of -40°F at 100 psig based on ISA 7.0.01.

c. Test Objective

i. Satisfactory results for 6.4.14a criterion as stated above.

ii. Actuated valves are fully cycled a minimum of 3 times and flow instrument loops respond per the design.

iii. Verify fan control using the control panel LVP-PNL-00003.

iv. Verify the fans produce the required flow and pressure.

6.4.15 The Completion Supplier provided lifting equipment, such as, but not limited to spreader beams, strong backs and yokes shall be tested in accordance with Section 9.4 of 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling and Storage Requirements*. Engineering Specification, 24590-WTP-3PS-G000-T0003, only requires custom spreader beams, strong backs, and yokes when these items are not available from commercial sources.

6.4.16 All overhead lifting points shall be proof tested. Test and examination certificates / documentation shall be provided to the Buyer for review. Lifts shall be conducted in accordance with the Buyer reviewed handling procedure.

6.4.17 Deleted

6.4.18 After the proof tests, the lift points shall be inspected.

6.4.19 The welds on fabricated lifting lugs shall be dye penetrant tested. Acceptance criteria shall be from the prevailing weld design code or standard.

6.4.20 Lift points shall be inspected for visual permanent plastic deformation of the material that may invalidate the design analyses for the lift points.

6.4.21 Deleted

6.5 Site Tests

The Buyer startup personnel shall perform acceptance tests after initial installation to confirm the Thermal Catalytic Oxidizer/Reducer and the associated Ammonia/Air Dilution unit meets the performance requirements specified in Section 3.4 of this specification.

7 Preparation for Shipment

7.1 General

The Thermal Catalytic Oxidizer/Reducer, catalysts, assemblies and the associated Ammonia/Air Dilution units shall be packaged, handled, and stored in accordance with the Buyer specification

24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling, and Storage Requirements*.

7.2 Tagging

7.2.1 A stainless steel nameplate shall be attached in a visible location to the Thermal Catalytic Oxidizer/Reducer and Ammonia/Air Dilution unit showing the manufacturer's name, shop location, date of manufacture, serial number, equipment rating, equipment tag numbers, weight of assembly and purchase order number.

7.2.2 Electrical/Control panels shall be tagged with component identification numbers per Attachment JQ07, Section 3.6.8 and Section 8.

7.2.3 Mechanical subcomponents (valves, strainers, expansion/flex joints, etc.) shall have component identification number engraved on a 1/16" minimum thick stainless steel tag with ¼" minimum character height, securely attached with 1/16" minimum diameter aircraft cable and ferrules.

7.2.4 Component identification numbers shall be as shown on the Buyer's P&IDs or MDSs attached to the MR, or will be provided via the Buyer markup of the Completion Supplier submitted drawings.

7.3 Nameplates

7.3.1 Permanent nameplates or labels shall be provided to identify each meter, relay, control switch, indicating light, circuit breaker compartment, and to identify all devices and terminal blocks within the compartments.

7.3.2 Exterior nameplates shall be made of laminated, beveled plastic of manufacturer's standard, with black lettering or numbering on a white background and shall be permanently affixed on the exterior. The method of affixing shall not violate the NEMA rating of the enclosure. Chloride / halide testing is not required for glue used to attach name plates.

7.3.3 Interior labels for all devices, parts and components shall be machine printed, permanent and self-adhesive labels. Chloride / halide testing is not required for self-adhesive labels.

7.4 Indoor storage

7.4.1 All line items/equipment shall be packaged per LEVEL C storage requirements. Level C: Indoor Storage (ASME NQA-1 2000 Level C). Materials shall be stored within a fire-resistant, weather-tight, and well-ventilated building or equivalent enclosure. Precautions shall be taken against vandalism. This area shall be situated and constructed so that it shall not be subject to flooding; the floor shall be situated and constructed so that it shall not be subject to flooding; the floor shall be paved or equal and well drained. Items shall be placed on pallets or shoring to permit air circulation.

8 Quality Assurance

8.1 General Requirements

This section does not delete or revise (but is in addition to) those requirements defined by the procurement documents. If a supplier believes that an inconsistency exists between this section and the procurement documents and referenced codes and standards, the Completion Supplier shall immediately notify the Buyer requesting resolution.

8.1.1 The Completion Supplier is responsible to promulgate the requirements of this specification to sub-suppliers providing items or services related to this procurement.

8.1.2 The Completion Supplier's QAP Requirements are included in the Buyer's specification 24590-WTP-3PS-G000-T0001, *Engineering Specification for Supplier Quality Assurance Program Requirements*.

8.1.3 The Completion Supplier's Quality Assurance Manual Document Number 40-001, Rev 4, dated 3/13/13 shall be submitted to the Buyer for review. All work shall be performed in accordance with their QL-3 program and QL-3 implementing procedures. A Commercial Grade Survey was performed at the Completion Supplier's facility October 7, 2013 in order to observe and record the process and controls to their QL-3 program. If at some time during this procurement the Completion Supplier revises their Quality Assurance Manual or implementing procedures, WTP procurement Engineering shall be notified immediately in order to assess the changes and determine the impact, if any, to the dedication of the LAW TCO and Ammonia Dilution skid (ADS).

8.1.4 For items designated quality level commercial (CM), no additional QA program requirements are mandated by the Buyer beyond the Completion Supplier's commercial QA program.

8.2 Quality Program Requirements

8.2.1 Deleted

8.2.2 The Completion Supplier must pass a survey by the Buyer.

8.2.3 The Completion Supplier shall allow the Buyer, its agent, and DOE access to their facility and records pertaining to this purchase order for the purpose of Quality Assurance Audits and Surveillance at mutually agreed times.

8.2.4 Deleted

8.3 Supplier Deviation

Each supplier shall be required to identify and promptly document all deviations from the

requirements of the procuring documents. In addition, the supplier shall be required to describe the recommended disposition for the Buyer's acceptance based on appropriate analysis. Submittals of request for deviations from lower-tier suppliers shall be through the prime supplier to the Buyer. The supplier-proposed deviations from procurement documents shall be initiated by use of Supplier Deviation Disposition Request (SDDR) form in Part 2 of the MR.

9 Configuration Management

Equipment and/or components covered by this specification are identified with plant item numbers shown in the MDSs. Each item shall be identified in accordance with Tagging in Section 7.2 of this specification.

10 Documentation and Submittals

10.1 General

The Completion Supplier shall submit to the Buyer Engineering and Quality Verification documents in the forms and quantities shown in Form G-321-E, *Engineering Document Requirement*, and Form G-321-V, *Quality Verification Document Requirements*, attached to the MR.

WTP specifications contain many submittal requirements. WTP does not require every submittal listed to be submitted. The required submittals are listed on the G-321-E and G-321-V forms.

10.2 Submittals

The Completion Supplier shall submit the following:

10.2.1 Drawings

Drawings shall be in accordance with ASME Y14.100 and show the following information:

10.2.1.1 The outline dimensions of each Thermal Catalytic Oxidizer/Reducer and Ammonia/Air Dilution units, including outline and detail drawings for each component. These drawings shall reflect the "as-shipped" configuration of the equipment and instrumentation.

10.2.1.2 Details of construction.

10.2.1.3 Mounting dimensions and information required for the design of supports and foundations.

10.2.1.4 Operating weight and center of gravity of each Thermal Catalytic Oxidizer/Reducer and Ammonia/Air Dilution unit.

10.2.1.5 The space required for the removal of components.

10.2.1.6 The location of access doors.

10.2.1.7 Deleted

10.2.1.8 Wiring and schematic diagrams. Diagrams shall include wire gauges and fuse sizes applicable to the supplied units only.

10.2.1.9 Deleted

10.2.1.10 Nozzle locations for connections to BUYER's process and utility piping including electrical and instrumentation connections.

10.2.1.11 Piping and instrumentation diagrams (P&IDs).

10.2.2 Procedures

Procedures shall include but are not limited to:

10.2.2.1 Completion Supplier's shipping preparation and storage procedures.

10.2.2.2 Startup, operation, shutdown, and idle procedures/manual.

10.2.2.3 Catalyst change out procedures.

10.2.2.4 Performance test procedures and acceptance criteria for shop tests.

10.2.2.5 Insulation installation procedures, for removable insulation.

10.2.2.6 Surface preparation and coating procedures for components specifically fabricated for the TCOs/SCRs.

10.2.2.7 Inspection and Test Reports

10.2.2.8 Performance test reports for shop tests.

10.2.2.9 Deleted

10.2.3 Deleted

10.2.3.1 Deleted

10.2.3.2 Deleted

10.2.4 Manuals

Manuals and instructions shall include:

10.2.4.1 Erection and installation manuals which provide complete, detailed procedures for installing and placing equipment in initial operation. The manuals shall include all erection and installation drawings. Refer to the Buyer specification 24590-WTP-3PS-G000-T0003 *Engineering Specification for Packaging, Handling and Storage Requirements*, for additional requirements.

10.2.4.2 Operation, accessibility, and maintenance manuals which provide complete, detailed descriptions of components and appurtenances with data sheets showing design, construction and performance data for equipment. Manuals shall include drawings required for operation, maintenance and repair, maintenance requirements, instructions and operational troubleshooting guides.

10.2.4.3 Instruction manuals shall cover items purchased, including materials that the Completion Supplier has obtained from a subcontractor. The supplier shall obtain such manuals and lists, and submit them to the Buyer.

10.2.4.4 The Completion Supplier shall provide instructions regarding transportation, site storage and preparation, and protection of equipment after installation and prior to operation. Refer to the Buyer's specification 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling and Storage Requirements*, for additional requirements.

10.2.5 Certificates of Conformance and Acceptance, as specified on the G-321-V form.

10.2.5.1 The Completion Supplier shall provide Certificates of Conformance demonstrating compliance with all applicable standards, specifications, and drawings. See Attachment 11 for a sample Certificate of Conformance.

10.2.5.2 The Completion Supplier shall certify lifting eyes or lugs and/or spreader bars are suitable for the safe, lifting, and handling of the equipment.

10.2.5.3 Attachment 7 provides the Certificate of Analysis (COA) for BASF Catalysts, LLC (VOCat 300S) used in Catholic University's Vitreous State Laboratory (VSL) testing. Prior to release for shipment the Completion Supplier shall provide the COA demonstrating the performance of the oxidation catalyst is equal to or better than the oxidation catalyst used in the reference VSL testing (Ref. MDS General Note 9) for the Buyer's acceptance.

10.2.6 Deleted

10.2.6.1 Deleted

10.2.6.2 Parts list, and cost for parts and items subject to deterioration and replacement.

10.2.6.3 List of recommended spare parts. The spare parts list shall include names of the original equipment manufacturer with appropriate part numbers.

10.2.7 Materials Certificates/Statistics

10.2.7.1 Deleted

10.2.7.2 Material Test Reports (MTRs), as specified on the G-321-V form. CMTRs, MTRs, C of Cs, etc. Are not required for non-permanent plant equipment.

10.2.7.3 Deleted

10.2.7.4 Deleted

10.2.7.5 Deleted

10.2.7.6 Material Safety Data Sheets (MSDSs).

10.2.8 Data

Data shall include:

10.2.8.1 The Buyer's Mechanical Data Sheets, completely filled out by the supplier, showing all information required to determine that the units are of the design and materials specified herein.

10.2.8.2 All data compiled during FT testing transmitted in a final report based on the Buyer's approved FT procedure/results/datasheet.

11 References

Design changes incorporated by reference:

24590-WTP-SDDR-MS-11-00054

24590-WTP-SDDR-MS-11-00200

24590-WTP-SDDR-MS-11-00298

24590-WTP-SDDR-MS-12-00094

24590-WTP-SDDR-MS-12-00110

24590-WTP-SDDR-MS-12-00167

24590-WTP-SDDR-MS-12-00173

24590-WTP-SDDR-MS-13-00001

24590-WTP-SDDR-MS-13-00006

24590-WTP-SDDR-MS-13-00023

24590-WTP-SDDR-MS-13-00074

24590-WTP-SDDR-MS-14-00002

24590-WTP-SDDR-MS-14-00003

24590-WTP-SDDR-MS-14-00004

24590-WTP-SDDR-MS-14-00042

24590-WTP-SDDR-MS-14-00048

24590-WTP-SDDR-MS-14-00049

24590-WTP-SDDR-MS-14-00050

24590-WTP-SDDR-MS-14-00061

24590-WTP-SDDR-MS-14-00062

24590-WTP-SDDR-MS-14-00064, superseded by 24590-WTP-SDDR-MS-15-00010

24590-WTP-SDDR-MS-14-00066

24590-WTP-SDDR-MS-14-00068

24590-WTP-SDDR-MS-14-00076

24590-WTP-SDDR-MS-15-00010

24590-WTP-SDDR-MS-15-00012

24590-WTP-SDDR-MS-15-00017

24590-WTP-SDDR-MS-15-00019

24590-WTP-SDDR-MS-15-00023

24590-WTP-SDDR-MS-15-00028

24590-WTP-SDDR-MS-15-00029

24590-WTP-SDDR-MS-15-00030

24590-WTP-SDDR-MS-15-00031

24590-WTP-SDDR-MS-15-00040

24590-WTP-SDDR-MS-15-00041

24590-WTP-SDDR-MS-15-00049, superseded by 24590-WTP-SDDR-MS-15-00057

24590-WTP-SDDR-MS-15-00050, superseded by 24590-WTP-SDDR-MS-15-00060

24590-WTP-SDDR-MS-15-00051

24590-WTP-SDDR-MS-15-00052

24590-WTP-SDDR-MS-15-00056

24590-WTP-SDDR-MS-15-00057

24590-WTP-SDDR-MS-15-00060

ATTACHMENT JQ07

LAW TCO CUSTOMIZED JQ07

24590-WTP-3PS-JQ07-T0001, Rev. 3, **SCN's 24590-WTP-3PN-JQ07-00015 & 00016 as applicable**
ENGINEERING SPECIFICATION FOR INSTRUMENTATION FOR PACKAGED SYSTEMS

This attachment defines the requirements for instruments, control devices, and control systems associated with the Low Activity Waste Thermal Catalytic Oxidizer/Reducer (LAW TCO). For continuity and maintaining configuration control, the section numbers from the specification noted above have been retained.

1.7 Work by Others

1.7.1 External Connections

All external connections of wiring and piping between the Supplier provided instruments and the Buyer's utilities are excluded unless specified in the RFP or otherwise agreed to by the Buyer and Supplier.

1.7.2 Instrument and Service Air

The Buyer will provide the following air sources for instruments and equipment:

Dry, oil and dust-free instrument air, 90 to 150 psig, with a dew point value of - 40 °F at 100 psig based on ISA 7.0.01. Service air, dew point –32 °F, 90 to 150 psig.

1.7.3 Power Supply

The Buyer will provide normal power and/or Uninterruptible Power Supply (UPS) for the Supplier's instruments unless otherwise specified on the parent specification. Each source will be delivered at 120 VAC, single phase, 60 Hz, grounded system. 480 VAC, 3 phase, 60 Hz power will be provided as required for motors. All other voltages required by the Supplier shall be derived from the Buyer provided 120 VAC or 480 VAC.

2.1 Codes

2.1.1 American Society of Mechanical Engineers (ASME)

ASME B31.3 (1996)	Process Piping
ASME/ANSI PTC 19.3	Performance Test Code for Temperature Measurement

2.2 Industry Standards

2.2.3 Telecommunications Industry Association / Electronic Industries Alliance (TIA/EIA)

TIA/EIA-232-F	Interface Between Data Terminal Equipment and Data Circuit-terminating Equipment Employing Serial Binary Data Interchange

TIA/EIA-485-A	Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems

2.2.4 Instrumentation, Systems, and Automation Society (ISA)

50.02, Part 2,3,4,5&6	Fieldbus Standard for Use in Industrial Control Systems Part 2 (1992), 3 (1997), 4 (1997), 5 (1998), 6 (1998)
S75.01	Flow Equations for Sizing Control Valves
S84.01 (1996)	Applications of Safety Instrumented Systems for the Process Industries

2.2.6 International Electrotechnical Commission (IEC)

IEC 60751	Industrial Platinum Resistance Thermometer Sensors
IEC 61508-2/3	Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems

2.2.7 National Electrical Manufacturers Association (NEMA)

NEMA ICS 6	Enclosures for Industrial Controls and Systems

2.2.9 WTP Project Specifications

24590-WTP-3PS-JQ00-T0004	Management of Supplier Software

3.3 Design Conditions

3.3.1 Units of Measurement

The following units shall be used for design parameters, calculations, and scales.

Positive gauge pressure	inches H_2O or psig
Vacuum	inches Hg Vac or H_2O Vac
Absolute pressure	inches Hg or psia
Differential pressure	inches H_2O or psi
Temperature	degrees F
Flow: Solids	lb/hr
Flow: Liquids and slurries	gal/min or lb/hr
Flow: Gases or Vapors	std ft^3/min (scfm), std ft^3/hr (scfh) or lb/hr
Flow: Steam or vapors	lb/hr
Level	inches, feet or %
Composition	%, Wt. Fraction or PPM
Density	lb/ft^3
Velocity	feet/second
Viscosity	centipoise (cP)
Current (Electrical)	ampere
Electrical Potential	volt
Resistance	ohm
Conductivity	micro-siemens (μS) per centimeter

3.3.2 Interlock and Alarm Requirements

Packaged systems shall be provided with a Common trouble (if specified) alarm, an Emergency shutdown alarm, and a Safety instrumented system (if specified) alarm to annunciate in the Buyer's control room. In addition, the following control requirements shall also be met:

- Field contacts shall open in the alarm condition
- Field contacts shall open to initiate shutdown
- Instruments and interlock systems shall be designed to be fail safe

3.3.3 Spare Capacity

The Supplier shall provide 25 percent spare intermediate terminal blocks and space for an additional 15 percent increase in terminal blocks.

3.3.4 Instrument Signal/Power Circuit Protection

Instrument circuits shall be protected and housed to meet the electrical area classification in which it is installed. The choices of housing shall satisfy all pertaining codes.

Intrinsically safe instrument systems should not be used, unless there are special site requirements, and then only with the Buyer's approval. Intrinsically safe system requires certification by Underwriters Laboratory (UL) or Factory Mutual (FM) Insurance Company.

Each PLC or controller discrete output signal shall have its own independent fuse. Fuses shall be located in the leg of the wiring scheme that provides power from the source to the field devices.

3.3.6 Local Control Panel Instrumentation Indicators

Local motor controls (i.e. single local/remote switch per equipment control panel, momentary forward/reverse for each motor) shall be provided on control panel for operating equipment in local mode. Local mode will allow control to be taken away from the control system. Operations will be performed from the control panel and will not be subject to ICN interlocks. Independent protection interlocks will remain in force to prevent damage to Supplier's equipment. Indicating lights for local control panels which include indications, status, and alarms from instruments and motor drives shall conform to the following requirements for indicating lights for status, alarms, information, or control:

Color	Meaning
Red	Stopped, Closed, OFF, Alarm
Green	Running, Opened, On
Yellow	Transition, Indeterminate, Force
Cyan (Light Blue)	Manual
Purple	Local Control (HMI Displays)
Clear	Local Control (Local Panels)

NOTE 1: Switches or control effectors shall be turned clockwise or moved upward to increase function or energize a device. For single switch multi-direction control a 3 position switch with center position spring return is recommended (i.e. Forward/Reversing Motors, etc.)

NOTE 2: Applicable standards and guidelines direct consistency of man-machine interface features in order to minimize operator errors. All control panels that are used for normal process operation should feature color-coding and display features that are consistent with the color scheme as defined in section 3.3.6 above. The color scheme applies to vendor packaged control indications as well as any

SELLER developed human machine interface screens. However, for control and indication panels that are intended for maintenance operation only, or that are not used for routine operator control, deviations from the color scheme listed above may be approved at the Buyer's discretion.

3.3.7 Push To Test Alarm Actuator

All alarm indicators (visual) and annunciators (audible), and all lights on Control Panels (ref 3.3.6) shall be activated with an integral momentary contact push to test feature or when a common momentary contact push to test button on the front of the panel is pressed. This function is provided to verify that the alarm and/or indication functions satisfactorily.

3.4 Controls and Instrumentation Requirements

3.4.1 General

It is the intention of this specification that the instrumentation and designated portions of the control system be designed, fabricated, and installed as far as it is practical to the Supplier's design offering. However, the Buyer will select specific manufacturers for purposes of quality and standardization of the instrumentation and control system throughout the WTP facility.

3.4.2 Controls

Control software provided by the Supplier shall be governed by 24590-WTP-3PS-JQ00-T0004.

3.4.2.1 WTP Integrated Control Network (ICN) Architecture

The Buyer has selected the Industrial^{IT} product line supplied by ABB Automation Inc. as the primary control system for the WTP facility. The selected platform is a highly versatile "hybrid" type system which is designed to implement the traditional Distributed Control System (DCS) applications as well as the traditional Programmable Logic controller (PLC) applications. For the purpose of standardization and maintainability, it is a requirement to utilize components from this manufacturer to the extent possible with packaged systems.

Packaged systems shall be integrated into the WTP ICN, the following options are available, listed in order of preference:

3.4.2.1.1 ICN Control Platform

This is the Buyer's preferred implementation method.

When the packaged system implements the ICN control platform it shall utilize the Buyer's selected manufacturer's control system hardware. This includes the processors, input/output modules, power supplies, communications hardware, etc. to be installed in the Supplier's supplied control cabinets. Dependent on the operational requirements of the package this could also include connectivity server equipment and operator interfaces.

The Buyer selected manufacturer's product line is a follows:

Description/Manufacturer	ABB
Controller Platform	AC800M
Input/Output Module Platform	S800
Software Development Environment	Control^{IT} for AC800M/C
Operate Environment	Operate^{IT}

All ABB hardware shall be procured by the Buyer on behalf of the Supplier for applications provided the agreement was made prior to the contract award.

Preliminary design for controls implementation shall be submitted for the Buyer approval prior to the detailed design effort.

3.4.2.1.2 Commercial-Off-The-Shelf (COTS) Controls

Procured packaged systems considered as COTS are acceptable for integration into the ICN systems. For this determination, COTS controls are control hardware/software which do not require customization or design engineering for use on WTP. The Supplier shall supply the interface to the ICN using ICN supported communication hardware as follows:

Package Description		Interface	Media
Status Only – No control via ICN	Limited data exchange – Preferred	Profibus DP®	Multimode Fiber Optic
	Limited data exchange – Alternate*	4-20 mA - AI/AO	Hardwired
		24 VDC - DI	
		Dry contact – DO	
	Significant data exchange	OPC over Ethernet	Fiber Optic
Control via ICN	Preferred	Redundant Profibus DP®	Multimode Fiber Optic
	Alternate*	4-20 mA - AI/AO	Hardwired
		24 VDC - DI	
		Dry contact – DO	

* Buyer approval is required for substitution of these or other alternative interfaces.
AI- Analog Input, AO- Analog Output, DI- Digital Input, DO- Digital Output.

3.4.2.1.3 Third Party Platform

If utilization of the Buyer's selected controls manufacturer is determined to be unfeasible, a third-party control platform can be utilized with the Buyer's concurrence. Unless otherwise stated, application software development will be by the Supplier. The interface of the third party platform to the ICN shall be per table shown in the above paragraph 3.4.2.1.2.

Preliminary design for controls implementation on the third-party platform shall be submitted for the Buyer's review prior to the detailed design effort.

3.4.2.2 WTP Integration

3.4.2.2.1 Interface Data Requirements

Where the application software is provided by the Supplier, the Supplier shall provide a complete listing and detailed description of data points available for integration into the Buyer's ICN for operational, maintenance, and archiving purposes. All required control points required for the appropriate level of ICN control shall be clearly identified. The list shall be submitted to the Buyer for review and mutual concurrence. The final submission listing shall include all applicable interfacing details (entity names, addressing, etc.).

Where the application software is provided by the Buyer, refer to paragraph 3.5 for software design documentation requirements.

3.4.2.2.2 Interface Integration Testing

The Supplier shall provide proposed Profibus DP®, Foundation® Fieldbus, protocol converters, and interface devices immediately after the 90% design review. This will facilitate testing at the Buyer's facility in Richland, WA. Previously tested devices by Buyer will not need to be supplied at this time.

3.4.3 Non-Safety Signal Transmission Interface

The Buyer is striving for a consistent implementation of the connection of field instrumentation and equipment to control systems throughout the WTP facility.

Preliminary design for connection of field instrumentation and equipment to control systems shall be submitted for Buyer review prior to the detailed design effort.

The Supplier shall organize circuits and circuit terminations in the Supplier's interfacing termination enclosures based on signal types or circuit configurations. These signal types will include AI, AO, DI, DO, serial, Profibus DP, Foundation® Fieldbus, etc., and should be further grouped by 2- wire, 3-wire, or 4-wire circuit configurations. Based on quantities of these types, cable requirements can be established early. Subsequent to the contract award, C&I will work with the Supplier to "assign" signals to specific circuits and I/O channels as soon as possible.

The Supplier shall apply the following process when determining connection type:

3.4.3.1 Foundation® Fieldbus

Where available, process instrumentation shall be Foundation® Fieldbus compliant. Foundation® Fieldbus interfaces to communicate directly with Fieldbus enabled instruments and equipment. All Foundation® Fieldbus devices supplied shall be registered with the Foundation® Fieldbus, compliant with the current version of the Interoperability Test kit at the date of the purchase order, and supplied with manufacturer developed Device Description files. Only the Buyer-approved Interfacing devices shall be used to convert signals from their standard format to the Foundation® Fieldbus protocol. These devices shall be supplied by the Supplier and used only when a native Foundation® Fieldbus device is not available. The same communication, testing, and registration requirements apply to Fieldbus converters as to native Fieldbus devices.

3.4.3.1.1 Foundation® Fieldbus Accessories

All FOUNDATION Fieldbus devices shall be pre-wired with Pepperl + Fuchs (P+F) connector V9-R-M2-S.

3.4.3.1.2 Software Validation and Documentation

The Supplier shall provide Device Description (DD) files with every Purchase Order data sheet release. Device Description (DD) files shall be the manufacturer developed files and submitted in their native electronic form for each firmware version in the order.

The Supplier shall provide a list relating tag numbers to firmware versions and DD files, such as a MS Excel spreadsheet file.

The Supplier shall include manuals that describe how to configure the Foundation® Fieldbus parameters for the device.

If the Supplier changed any Buyer configurable parameters from their default state, these setting shall be documented on a per tag basis.

If the factory calibration settings are available and modifiable by the user, the Supplier shall document the settings and provide the settings along with the calibration certificate for each device.

The Buyer's control system can manage all parameters that are accessible though the Foundation® Fieldbus interface. However, if the Buyer is required to set any additional parameters that are available only though an alternate interface such as FDT/DTM, the Supplier shall provide the necessary hardware (cabling / hand held units) and software, including licenses, to interface with the device.

3.4.3.2 Profibus DP®

Communication interfaces to intelligent mechanical handling and electrical equipment shall be Profibus DP® compliant. Profibus DP® communication link shall be used to interface controllers directly with devices such as "intelligent" motor control centers (MCCs) and variable frequency drives (VFDs). All Profibus DP® devices shall be supplied with .GSD files and documentation describing data interchange. Other interfaces, such as DeviceNet®, AS-Interface®, TIA/EIA-232/485, etc. may be utilized with the appropriate converters with the Buyer's approval. The Supplier supplied conversion modules will be used where required. When Profibus DP® is the communications link between the Buyer's control system and the Supplier's control cabinets the following shall apply:

3.4.3.3 Communication Network Interface

The Buyer has selected the Industrial^{IT} platform from ABB, Inc. as the primary control system for the Buyer's facility. A Profibus DP® communication network will be used to communicate to drives and intelligent positioning instruments. The Supplier shall provide the following components for a Fiber Optic cable interface:

3.4.3.3.1 Profibus DP® Communication Interface

The Supplier shall provide a native Profibus DP® slave interface for the control panel or instrument and the associated drivers (GSD files) for communication with the Buyer's control system. The interface should support communication speeds up to 12 Mbit/sec over the Profibus DP® network.

3.4.3.3.2 Fiber Optic Connections

The Supplier shall provide the following component for proper network communication:

a) The Supplier shall install a Hirschmann OZD Profi 12M G12 fiber optic converter within the control panel or near the instrument for each communication network.

b) The Supplier shall derive the appropriate power to the fiber optic converter(s) from the control panel power feed. Where the Buyer provided a 120V single phase UPS supply, this supply shall be used to derive the 24VDC supply for the fiber optic converter. Where the only supply available from the Buyer is 480V 3Φ, then the Supplier shall use this to derive the 24VDC supply for the fiber optic converter. A separate power supply shall be provided for each communication network.

c) The Supplier shall follow the general fiber optic requirements described in section 3.4.3.5

3.4.3.3.3 Alternate Communication Interface

If a native Profibus DP® interface is not available, then the Supplier may propose an alternate communication interface or network that is compatible with the Buyer's control system for the Buyer's consideration and approval. If an alternate communication interface is proposed:

a) The Supplier shall provide all necessary interfaces or converters required to provide the Buyer's control system with the appropriate communications.

b) The Supplier shall provide any required drivers, software, and protocol conversion information to the Buyer for design, development, testing, and maintenance of the supplied networks and interfaces for the period of performance of the contract, including software or firmware upgrades or revisions.

c) The Supplier shall provide a description and examples of all required conversions between protocols and/or communication networks including required software applications and hardware components.

3.4.3.4 Classic I/O

If bussed communications are not feasible for connection of field instrumentation and equipment to control systems, standard Input/Output modules shall be used. Circuit design shall account for the WTP preferred I/O module types, as follows:

Analog Inputs – 4-20 mA current
Analog Output – 4-20 mA current
Discrete Input – 24 Volt dc
Discrete Output – 24 Volt dc

I/O modules shall be optically isolated from input and output wires to protect logic circuitry from high voltage transients. All output circuits shall have over-current protection. The I/O modules shall be of the plug-in type and shall be removable without turning off the power or disturbing field wiring ("hot swappable"). The I/O assemblies shall have indicators that are visible during operation to display the status of the I/O interface and individual I/O channels.

3.4.3.5 Fiber Optic Interface

For equipment packages that include a fiber optic interface the Supplier shall provide a fiber optic connection to the control panel or instrument per the following requirements:

a) The Supplier shall use 50/125 glass fiber patch cables to connect between the fiber optic patch plate(s) and the fiber optic converter(s). Any unused fiber optic connections shall be fitted with protective caps to guard against extraneous light and dust.

b) The Supplier shall utilize a Corning MT-RJ patch plate mounted in a protective housing to provide cable management, strain relief, and fiber protection.

c) Fiber optic patch cables shall utilize unpinned MT-RJ connectors on the converter side of the patch plate. Buyer-installed field cables will utilize pinned MT-RJ connectors.

d) For installations that have 24 fibers or less, the Supplier shall install a Corning CCH-CP24-97 patch plate and SPH-01P Single Panel Housing.

e) For installations that have more than 24 fibers, or where multiple fiber optic cables will be terminated on the field-side of the patch plate, the Supplier shall install the appropriate number of Corning WIC-02P or WIC-04P housings with corresponding CCH-CP24-97 patch plates.

f) All fiber optic designs and installations shall follow the manufacturer's guidance including equipment mounting, bending radius, strain relief, fiber termination, fiber and cable protection, and related items. The Supplier's designs shall make provisions for installation of Buyer's field cables that also meet these requirements.

3.4.5 Instrumentation Requirements

Instrument ranges shall be selected such that the normal operating point is between 35 and 75 percent of the range of the instrument. Except where the Buyer has specifically identified manufacturer and model, all the instruments shall be selected by the Supplier in accordance with guidelines provided herein. The instruments described below shall be selected to meet the required safety classification, specified quality, and the design criteria stated herein and in the primary equipment specification. The systems designed and fabricated shall meet the specified reliability and availability for each system or component.

The Supplier may suggest alternative instruments based on their past experience with similar applications subject to the Buyer's review and concurrence.

3.4.5.1 Flow Measurement

Flowmeters shall provide sufficient turn down ratio to accurately cover the required operating ranges of the Supplier's provided system and when installed shall meet the Buyer's required operational accuracy as stated in the package system specification. Isolation and drain valves shall be installed to allow inline flowmeters to be removed and replaced without having to completely drain the pipe.

Flow measurement devices shall be selected that are optimized for the application and environment of the measured fluid. This includes installation constraints, ambient conditions, and process conditions of the measurement device. The following describes the Buyer's requirements for specific type of flow measuring elements and systems.

3.4.5.1.1 Head Type Flowmeter

Head producing flow elements shall be located and installed in straight runs of pipe in accordance with the American Society of Mechanical Engineers (ASME) Standard MFC-10M.

Differential pressure transmitter in conjunction with concentric sharp edged orifice plates shall be considered for flow measurement devices where a turndown of less than 5, a significant permanent head loss, and an accuracy of ±2% of full scale for liquid or gas flow is acceptable. The calculated d/D (Beta ratio) shall be within the limits of 0.2 and 0.7. Two sets of flange taps with one set plugged and seal welded as a spare shall be supplied. The orifice plate shall be of 304L SS minimum and compatible with process fluid and shall comply with ASME MFC-14M-2003 or ASME MFC-3M-1989. Straight piping runs shall be per API Ch 14, Sec 3, Part 2. Honed meter runs shall be used for orifice measurements for line sizes less than 2".

3.4.5.1.4 Coriolis Mass Flow Meter

Coriolis flow meters may be applied to most liquid and some high pressure gas services where accuracy of less than 0.5% of measurement is required. It shall be considered for service applications requiring up to 50 to 1 turndown. The meter shall be sized for the desired accuracy at minimum and normal flow rate without exceeding the permissible pressure drop at the maximum flow rate. The meter shall be also considered for the service where process temperature and density measurement are also required. The meter shall be securely mounted in a vibration-free location in accordance with the manufacturer's recommendations.

3.4.5.1.8 Turbine Meter

Turbine meters shall be considered for clean low viscosity process streams, where there is no plug flow or water hammer; where higher rangeability (> 10 to 1), an accuracy of ±0.5%, and flow totalization is required. API MPMS standard and ISA RP-31.1 should be consulted regarding proper installation and calibration requirement.

3.4.5.1.9 Vortex Flow Meter

Vortex flow meters shall generally not be considered unless suitable alternate means for measuring flow are not practical. Vortex flow meters have a minimum of 10 to 1 rangeability and low head loss. They are generally applicable to liquids of low viscosity (<10 cP) and are often unsuitable for low pressure gas service. Vortex flow meters are vibration sensitive so they should not be located in the vicinity of large rotating machinery or in lines with hydraulic noise. The meters exhibit an unusually large low flow cut-off. The impact of this loss of signal from the meter on safety and process controllability should be evaluated for application.

3.4.5.2 Temperature Measurement

Temperature measurement devices shall be selected that are optimized for the application and environment of the measurement services. This includes installation constraints, ambient conditions, and process conditions of the measurement devices. The following describes the Buyer's requirements for specific types of temperature measuring elements and systems.

3.4.5.2.1 Temperature Elements

All temperature elements, Thermocouples (T/C's) or Resistance Temperature Devices (RTDs), shall be installed in thermowells to permit removal without process disturbance except where there is no risk to personnel from the process fluid during removal of the measuring element, i.e. shell skin, motor bearings and motor windings. Where a thermowell is not used, and the temperature element is not surface mounted, a permanent label shall be affixed to the primary element, indicating that there is no thermowell.

Sheathed RTDs with transmitters shall be used for remote temperature indication.

Sheathed, grounded junction type E T/C's are preferred temperature sensors when process conditions prohibit the use of RTD's, types J & K T/C's are allowed. T/C's shall be according to ISA MC96.1 or equivalent. Underground junction T/C's shall be used where the process fluids or equipment are at a potential above ground that could lead to dangerous conditions for maintenance personnel and signal conditioning equipment.

Use T/C where:

- No air permit functions are supported by the device.
- The temperature sensor is installed in a high vibration environment; or
- A temperature span exceeding 1400°F is required; or a response time of less than four (4) seconds is required.
- Unsheathed tip thermocouples shall be used where induced electrical voltages or high potentials may be present (e.g. in the measurement of bearing temperature in electrical machinery.)
- Motor bearing temperature measurements may use thermocouples provided local transmitters are used.

RTD elements shall be Platinum with a nominal resistance of 100 Ohm at 0 °C (32 °F). The resistance-vs.-temperature characteristic curve shall conform to DIN 43760, IEC 60751 with a temperature coefficient of 0.00385 ohms/ohm/°C. Three wire element design shall be used.

Unless otherwise specified, RTDs shall be sheathed with Magnesium Oxide insulation. The sheath shall comply with ASTM A276, 316L and ¼" diameter as a minimum. All T/Cs or RTDs shall be duplex design, spring loaded, and supplied with a connection head with internal grounding screw and external ground terminal. All elements shall be connected in the connection head.

Temperature measurements using RTDs shall use remote mounted transmitters with the appropriate input/output voltage isolation and located in the field or panel to connect an isolated signal to the Buyer's or Supplier's control system.

Test thermowells shall have a plug or cap permanently attached with a chain or wire and labeled as a test point.

3.4.5.4 Absolute, Gauge, and Differential Pressure Measurement

Pressure instruments shall be ranged for normal operation at 40-60% of scale for pressure gauge and transmitters.

3.4.5.4.1 Pressure and Differential Pressure Transmitters

Pressure and differential pressure transmitters shall have the following performance as a minimum:

Standard accuracy:	±0.15% of calibrated span for ±50°F temperature changes for rangedown of 5:1 or less
Rangedown ratio:	30 to 1 minimum
Overall stability:	±0.125% of upper range limit for ±50°F temperature changes over 5 year period

For draft range differential pressure transmitters the available spans shall be 0.1 to 3.0"WC. The accuracy shall be ±0.10% of span with a stability of ±0.2% of span per year.

Wetted parts shall be a minimum of 316SS for flanges and 316L SS for the process isolating diaphragm. Mounting bolts shall be 316 SS. Pressure transmitters shall normally be gauge pressure type referenced to atmospheric pressure.

On low pressure applications where composition is being controlled using the pressure measurement, absolute pressure type transmitters referenced to a constant true zero pressure shall be used. Filled fluid shall be compatible with process material, pressure, and temperature. When required by the physical properties of the process fluid, a factory sealed filled system with a diaphragm shall be considered, although these should be avoided at low differential pressures. The capillary should be protected by a 316SS armor. Differential pressure transmitters shall be rated for a minimum 1000 psig static pressure and shall be able to withstand overrange pressure equal to the meter body rating and the pressure conditions or relevant piping specifications.

3.4.5.4.3 Pressure Gauges

All pumps, except sump pumps, shall have a discharge pressure gauge and a suction pressure test connection. Pressure gauges shall be provided downstream of pressure reducing stations and with blind pressure switches.

Pressure indicating scales shall be graduated in direct engineering units for the range specified. Pressure gauges shall be 4 ½" diameter, ½" MNPT bottom connection, plastic case, white laminated phenol dials with black graduations. Process gauges shall be solid front with a blowout back. Movement may be either rotary geared stainless steel or cam and roller type. Accuracy shall be 0.5% of full scale. Bourdon tube, socket, and tip shall be stainless steel or suitable alloy for specific services. Back-of-panel receiver gauges used for testing shall have 2 ½ inch dial.

Pulsation dampeners or snubbers shall be required on all pulsating services such as reciprocating pumps and compressors. Other applications where severe service from pulsating pressure is anticipated, pulsation dampeners may be specified at engineer's discretion. Dampening shall be provided by liquid filled gauge bodies.

Gauge ranges shall be selected such that the operating pressure falls between 40 to 60% of the gauge scale.

3.4.5.5 Control Valves

Valves shall be sized per ISA S75.01. Valves shall be sized to control normal operating design flow at 50% to 70% of its maximum opening. Valves shall be sized to be no more than 90% open at maximum operating flow and no less than 10% open at minimum operating flow. If calculated Cv dictates valve size two line sizes below process line, reduced trim in valve one line size below process line shall be used. The valve shall be selected and sized so that the installed rangeability is at least 20:1.

The potential for cavitation shall be evaluated and the valve size, trim, or type selected to prevent the occurrence of cavitation.

The valve trim shall be selected so that the installed operating characteristics of the control valve shall be nominally linear over the operating flow range. To achieve this, equal percentage trim shall normally be used for control applications except for some applications where linear trim is required. Linear trim shall be used for those applications where the pressure drop across the control valve is more than 50% of the upstream pressure or constant pressure across the control valve. A quick opening valve characteristic shall generally not be used for throttling services. Valve trim materials shall be as follows:

1. For metal to metal seating configuration, 316L SS shall be the normal and minimum acceptable material.
2. Stellite faced seating surfaces or other approved hardened materials shall be provided in difficult services, i.e. cavitation or flashing.
3. Soft seat trim material shall be used when bubble-tight shut off is a requirement or where determined by the process fluid's corrosiveness. Elastomer used for seating material shall be compatible with process fluid and service application.

Valves with soft seats shall be used within the limitations of the seating materials for positive bubble tight shut-off. On/off valves shall have integral solenoid pilots and limit switches. Foundation® Fieldbus compliant topworks are preferred by the Buyer for on/off valves. Seat leakage shall be in accordance with ANSI/FCI 70-2 seat leakage definitions and requirements. Fire testing and certification of on/off valves shall be in accordance with provisions of API SPEC 6FA or API STD 607. It should be noted that this testing does not qualify control valves to meet redundancy separation / single failure criteria requirements of Section 4.5-1 of the Safety Requirements Document.

Spring opposed pneumatic diaphragm actuators shall be the normal mechanism for operating throttling valves. Actuator sizing shall permit full valve stroking against the maximum process differential pressure and spring tension with the available instrument air supply pressure and output from positioner. Piston actuators shall be used where stroke length or thrust required exceeds that available from diaphragm actuators, or environmental conditions preclude the use of diaphragm actuators.

Valve positioners shall be furnished for all control valves. Positioners shall have input, output(s), and supply pressure gauges. Any split range requirements shall be achieved by using the control system. The failsafe action of the valves shall be determined by process requirements with regard to safe operation and emergency shutdown requirements and shall be marked on P&IDs. Foundation® Fieldbus positioners shall be supplied for all non-Safety valves and standard positioners shall be supplied for all SAFETY SSC valves. Remote Foundation® Fieldbus positioners shall be supplied where valve environment precludes the use of microprocessor based devices.

All valves shall be designed to meet the maximum noise level as defined in OSHA paragraph 1910.95. Maximum noise level is defined as 85 dBA when measured 3 feet from the valve under normal operating conditions. Noise prediction methods shall be those recommended by the specific valve Supplier.

Limit switches shall be hermetically sealed and suitable for mounting on the valve. Independent switches shall be provided as required for valve open and closed positions.

When control valves are installed in horizontal lines the actuator shall be installed above the line. Sufficient clear space shall be provided above the valve to allow removal of the top works with stem and plug as an assembly. A hand-wheel shall be furnished on each accessible control valve

where required for manual control during upset conditions. Modulating control valves shall be provided with isolating block valves, gate or globe type, and vent/drain valve to allow the control valve to be taken out of service and a globe bypass valve for hand control, if required and approved, around the control valve during the time the control valve is out of service. Both isolating block valves and bypass valve shall have flow capacity more than control valve capacity.

3.4.5.6 Solenoid Valves

All solenoid valves shall operate with zero pressure differential and shall close against the maximum design differential pressure. Solenoid valves shall be suitable for the environmental conditions and the electrical area classification specified in the referenced material requisition or data sheet. Solenoid coils shall be rated for continuous operation and heavy duty type equipped with class H insulation and a minimum of temperature class T3 encapsulated coils. Low wattage type shall be supplied for 24VDC applications and shall not exceed 12 watts. Coil enclosures shall include provisions for terminal connections rather than pigtails and have ¾ inch or ½ inch NPT conduit connections. Vent port is to be fitted with a bug screen.

3.4.5.7 Limit Switches

Limit switches shall be electromechanical type with lever arms, pushbuttons, or cams as actuators that operate momentary contacts.

Switch contacts, if supplied, shall be snap action, hermetically sealed design and suitable for the environmental conditions where they're located. As a minimum, switch contacts shall be of a Single-Pole-Double-Throw (SPDT) design. Contact rating shall be at a minimum 5A @ 120 VAC or 2.5A @ 24 VDC.

Limit switches shall be mounted such that actuation does not cause damage or excessive limit switch movement.

3.4.5.16 Rotating Equipment Monitoring Systems

Detection of imminent machine failure in time to safely shutdown the associated process shall be provided as required by the primary equipment specification. Instrumentation required to protect rotating machinery from damage is addressed herein.

3.4.5.16.1 Machinery Parameters for Monitoring

Machinery requiring high availability should be provided with sensors to continuously monitor:

1. Both radial vibration (X and Y directions) and thrust of shaft
2. Temperature of all journal and thrust bearings
3. Lubrication system operation including oil pressure and temperature
4. Rod drop and impact monitoring for reciprocating compressors.

Consideration shall also be given to providing seal system leak detection.

The Supplier shall provide and install non-contacting vibration and position sensor probes for machine monitoring of both radial vibration and thrust position of the shaft. The installation of all bearing thermocouple and shaft position monitoring equipment shall be in accordance with API 670. Bearing thermocouples shall be type E calibration.

3.4.5.16.2 Shaft Speed Monitoring and Control

Speed transmitters shall have sensors of non-contact type. Speed control of rotating equipment shall be accomplished by the use of speed transmitters and fast response control loop, Electronic governors are preferred where machine speed regulation is important for process control. Overspeed protection independent of the governor should be provided.

3.4.6 Safety Instrumentation and Controls

3.4.6.1 SS instruments serving an active safety function and designated as "Z" instruments have been deleted from the Supplier's work scope.

3.4.6.1.1 Deleted

3.4.6.1.2 Deleted

3.4.6.2 Deleted

3.4.6.3 Deleted

3.4.6.4 Deleted

3.5 Deleted

3.6 Enclosures, Cabinets, Panels, and Racks Requirements

The Supplier shall provide the instrument enclosures, cabinets, panels, and racks necessary to support the instrumentation and control systems required by the primary equipment specification. Instruments that require physical or environmental protection shall be installed in enclosures that meet the specifications of this section. Instruments that have a construction and NEMA rating that permits unprotected installation in the field shall be either individually field mounted or installed on open instrument racks that meet the requirements of this section. Operator control panels for interfacing to the control systems shall meet the requirements of this section. All enclosures, cabinets, panels, and racks shall be designed and fabricated to be in full compliance with NFPA 70-1999.

3.6.1 Rating and Type

All enclosures shall be designed for front access only unless otherwise specified. All components and equipment in the enclosure shall be accessible and removable from the front. Enclosures shall be either outdoor, indoor, hose down, or corrosive environments per the NEMA 250 and ICS 6 standards based on the environmental specification requirements. In the absence of a specific NEMA requirement in the main mechanical package specification, a NEMA rating of 12 shall be the minimum acceptable requirement for indoor and NEMA 4X for outdoor. In areas where radioactive contamination is likely, only stainless steel enclosures shall be used.

3.6.2 Enclosure Internal Environmental Conditions

The enclosure design shall ensure that no internal equipment or component is subjected to levels of dirt or dust that exceed those specified by the equipment or component manufacturer. The temperature inside of the enclosure shall not exceed the maximum and minimum operating temperatures of any device located within it.

Natural convection and conduction cooling is the preferred method of dissipating heat within the enclosure. If "Hot Spots" such as those generated by power supplies or other electrical equipment are present, or an internal temperature exceeding 100 °F is anticipated, the enclosure shall be fitted with adequately sized ventilation fans where ambient conditions permit.

Where forced-air cooling is necessary and practicable for proper operation of the apparatus housed in the enclosure, the Supplier shall provide special filters, blowers or other suitable filtration or cooling devices that will meet the requirements of NEMA 250 and ICS 6.

The Supplier shall provide enclosures with thermostatically controlled space heaters, where required by ambient conditions, to maintain temperature above dew point and above freezing. If equipment is located outdoors, space heaters must be provided, unless otherwise stipulated by the Buyer.

The Supplier shall provide all mounting brackets, wire, and equipment needed to attach the heating or cooling devices to the enclosure without degrading the NEMA 250 and ICS 6 enclosure requirements.

3.6.3 Mechanical Requirement

Freestanding enclosures shall be fitted with a base, have rigid bracing, removable lifting eyes and include provisions for securing to floor with anchor bolts or bolted or welded to the Buyer's floor embed. Wall mounted enclosures shall be sized by the Supplier and shall include all rigid bracing, door latch, and mounting fixtures needed to mount the enclosure to the wall.

Where lockable enclosure doors are specified on the primary equipment specifications, datasheets, or drawings, the doors shall have a common key lock. The Buyer will review and concur with the key arrangement and selection. All packaged systems and equipment controls shall be pre-wired to terminal blocks in permanently mounted enclosure.

The terminal blocks shall be designed for easy interconnection to the Buyer's control and communication circuits (see section 3.4.3 design requirements of this specification for signal transmission interface).

Interconnecting wire shall be run in intermediate metallic conduit. Interconnecting Fieldbus communication cables shall be armored type and supported in unistrut channel or on existing structure.

Access to enclosure internal components or equipment shall not require the use of hand tools other than for opening the door. Access to any component within the enclosure for maintenance or replacement shall not be prevented by proximity to other components within the enclosure. Equipment mounted in the rear of the enclosure shall be on a back-panel and positioned to facilitate removal and replacement. Enclosure back-panels shall be fabricated from low-carbon steel and shall be finished with semi-gloss or gloss white paint. Enclosures shall be sized to allow clearance between the enclosed components, cables, print pockets, and components mounted on the door.

Suites of enclosures shall be designed to accommodate shipment for a two bay interface. Where a suite of enclosures is made of discrete cabinet sections that will be separated for shipment and movement on site and then reconnected in the same configuration, provisions shall be made (such as the inclusion of dowel pins) for the alignment to be reproduced on site. If two or more enclosures are connected and share wiring, the side-panels they share shall be removed.

Where enclosures are to be installed by the Supplier, they shall be placed in a position that allows the doors to be opened fully for easy access to wiring and components for maintenance, testing and troubleshooting.

Where enclosed or protected installation is not required, then racks shall be used for mounting instruments to provide ease of maintenance and calibration. The rack frame for mounting non-Safety instruments shall be constructed of stainless steel unistrut channel and stainless steel unistrut systems components and designed to support the weight of installed instruments. The rack frame for mounting SAFETY SSC instruments shall be designed, constructed, and qualified to the requirements stated in the primary equipment specification. Free standing racks shall be fitted with a base, rigid bracing, and lifting eyes. Racks shall also include provisions for securing to walls or floor with anchor bolts or bolted to the Buyer's embed. All rack mounted instrumentation shall have NEMA 4X rating or better.

3.6.4 Enclosure Segregation Requirements

Deleted

3.6.5 Enclosure Grounding Requirements

The enclosure grounding system shall be installed in conformance to IEEE Guide 1050-1996, section 5.3.1 "Single point grounding system". All instrumentation enclosures shall have an equipment safety ground bus and an isolated signal ground bus, except instrument junction box. Instrument junction box shall only have an equipment safety ground. The grounding bus shall be constructed with solid copper, and all connections shall be drilled and tapped. The ground bus shall be drilled and tapped for an additional 20 percent spare terminations.

The equipment safety ground bus shall be solidly bolted to the enclosure structure. Where enclosures are to be connected together after final installation, each end of the safety ground bus will include provisions for connection to the adjacent enclosure safety ground bus. A bolted compression type 2/0 terminal lug shall be installed at each end of the bus to facilitate connection of the Buyer's 2/0 AWG stranded copper ground cable.

All removable metal components shall be connected to the equipment ground bus. Enclosure and back-panel shall be bonded to the equipment ground. Grounding for electrical devices and instruments, including signal and power supply shall be in accordance with manufacturer's recommendations and applicable NEC requirements. Instrument cable shield and signal common conductors shall be connected to the isolated signal ground bus, unless otherwise required by the manufacturer.

The isolated signal ground bus shall be electrically isolated from the enclosure structure and the safety ground bus. A bolted compression type 2/0 terminal lug shall be installed at each end of the isolated ground bus to facilitate connection either to another isolated signal ground bus in a connected adjacent enclosure or to the Buyer's 2/0 AWG stranded copper ground cable.

Instrument cable shields and signal common conductors shall be connected to the isolated signal ground bus. Each signal ground conductor shall be fastened to the isolated signal ground bus. For junction boxes with signal wiring going back to the Buyer's control system, the cable shield shall be terminated on an isolated terminal block and carried back to a ground supplied by the Buyer. Ground conductors connected to the isolated signal ground bus shall have an insulation color code of green with yellow tracer.

3.6.6 Electrical and Wiring Requirements

The Supplier shall mount, connect and wire each instrument or control device such that adjustment, maintenance, removal and replacement may be accomplished in a safe manner without interruption of service to adjacent but unrelated equipment and without placing undue stress on installed wiring or devices. Accommodations for strain relief shall be made when routing wire to hinged enclosure doors and shall be wrapped with spiral wire wrap.

Terminal points shall be used for only one wire unless specifically identified for more than one wire by an NRTL. Wire splicing shall not be used unless approved by the Buyer. Bridge or comb jumpers shall be used for adjacent terminal connections. Jumpers shall not be installed on the field side of the terminal strip.

Terminal blocks shall incorporate the following features:

Space saving design
Screw clamp wire connection
Single level configuration
Integral test facilities
DIN-rail (35mm) mounted

Isolating type terminal blocks shall be Weidmuller "W" series, Allen Bradley 1492-JKD3TP, Phoenix Contact, or Buyer approved equal. Non-isolating feed-thru terminal blocks shall be Weidmuller "W" series, Allen Bradley 1492-W4, Phoenix Contact, or Buyer approved equal. Terminal blocks for the

incoming power supply shall be capable of connecting #4 AWG to #12 AWG conductors, such as Allen Bradley 1492-W16S, or Weidmuller WD 35. The terminal blocks for incoming 120 VAC power and 120 VAC power distribution shall provide separation between Control/Instrumentation power and enclosure utility power, with separate termination points for each. Enclosure utilities include convenience accessories, cooling fans, and heaters.

All terminal blocks shall be identified by a unique terminal block number and approved by the Buyer.

For all enclosures, each incoming power supply shall be provided with circuit protection and shall have a manually actuated electrical power disconnect device mounted on/in the enclosure in an easily accessible location. The electrical power disconnect device may be a single device or multiple devices for individual circuits.

Each device that uses 120 VAC for power shall have individual connections protected via rail mounted circuit breakers. The circuit breakers used for individual control or power circuit protection within the enclosure shall be thermal magnetic breakers such as Weidmuller CB, Allen Bradley type 1492, Phoenix Contact, or Buyer approved equal. The circuit breakers used for individual control or power circuit protection external to the enclosure shall comply with UL489. They shall be Dual-In-Line, DIN-rail mountable TS35, TS32, or equivalent. Power shall not be "daisy chained" from instrument to instrument; however, the bridge or comb jumpers may be used on the supply side of the circuit breakers. A fuse and circuit breaker directory shall be contained in a holder permanently affixed on the inside of each door or back-panel and protected by a clear window.

All internal enclosure wiring shall be neatly dressed in slotted non-metallic wireways. The wireway shall be securely fastened to the enclosure back-panel by use of Stainless Steel screws. Circuits of different voltages (service level) shall be terminated on physically separate terminal strips and clearly labeled to show the circuit voltage. Terminal blocks shall be segregated according to signal type. In the event SIS system components are included in an enclosure, the wiring shall be clearly identified and segregated from non SIS circuits.

See table 1 for the instrumentation cable schedule:

TABLE 1
Instrumentation Cable Schedule

Cable Code		Cable Desc.	Specific Cable Spec	Comments	Circuit ID	Cable General Spec (superceded by specific cable specification)
Inst. cables-analog circuits	**In SR**	**Analog signals**				
1TSPR#16	X	Single twisted pr, #16AWG, 300V, ITC, PLTC	Single twisted pair with overall foil shield	Individual instrument signals, instrument 24 vdc power	Black, White	Cables UL listed as ITC and PLTC, 300 V insulation, UL1581 listed for 70,000 BTU vertical tray flame test; 100% foil polyester/aluminum individual and overall shields with 22AWG drain wire. Each circuit shall have a minimum of 6-8 twists/ft.
2TSPR#16	X	Two twisted shielded pr #16AWG, 300V, ITC,PLTC	Individually twisted shielded pairs with overall foil shield		Black, White conductors -individual circuits numbered	
Inst. cables-thermocouple circuits	**In SR**	**Thermocouple signals**				
1JX#16	X	Single twisted pr, #16AWG, 300V, ITC, PLTC	Single twisted pair with overall foil shield	Type J thermocouple - iron (+), constantan (-)	White (+), Red (-)	Cables UL listed as ITC and PLTC, 300 V insulation, UL1581 listed for 70,000 BTU vertical tray flame test; 100% foil polyester/aluminum individual and overall shields with 18AWG or 22AWG drain wire.
1KX#20	X	Single twisted pr, #20AWG, 300V, ITC, PLTC	Single twisted pair with overall foil shield	Type K thermocouple - chromel (+), alumel (-)	Yellow (+), Red (-)	
Data communication cables	**In SR**	**Foundation Fieldbus**				
1TSPR#18FF	X	Single twisted shielded pair, Foundation Fieldbus	Foundation Fieldbus Type ER crush resistant cable, orange jacket, preset lengths with Pepperl-Fuchs connectors	Pepperl-Fuchs FieldConnex mini cordsets, Belden 3076F	Blue (-) pin 1; Orange (+) pin 2; Shield pin 3; not used pin 4	Cable UL 1581 listed for 70,00 BTU vertical tray flame test, 100% foil polyester/aluminum overall shield with 20 AWG drain wire
Instrument cables-digital circuits	**X**	**Discrete I/O**				
use 1TSPR#16 above	X	Single Twisted pr #16AWG, 300V, ITC, PLTC	Single twisted pair with overall foil shield	Individual instrument signals, instrument 24 vdc power		Cables UL listed as ITC and PLTC, 300 V insulation, UL1581 listed for 70,000 BTU vertical tray flame test; 100% foil polyester/aluminum individual and overall shields with 22AWG drain wire. Each circuit shall have a minimum of 6-8 twists/ft.
2TPR#16	X	Two twisted pr #16AWG, 300V, ITC, PLTC	Individually twisted pairs with overall foil shield	Valve limit switches, process switches	Black, White conductors -individual circuits numbered	

AC power shall be routed through separate wireways or separated with a divider from 24 VDC discrete and analog instrument signals within enclosures. Power and signal cabling shall not be run in parallel, except in separate wireways, and should cross at a 90-degree angle only.

The interior of each Freestanding, floor-mounted enclosure shall be equipped a 120 VAC light and switch. The enclosure shall be equipped with a 120 VAC duplex receptacle. Route wiring within the enclosure for convenience power receptacles, cooling fans (where approved), and space heater (if required) in accordance with standard industrial practice. The Supplier shall derive power for these components from the Buyer provided 480 VAC power supply. If a 480 VAC power supply is not available, the Buyer will provide the 120 VAC supply. Control and instrumentation power sources shall be separate from utility power sources.

All instrument signal cables shall be of the type and specification as listed in Table 1– Instrumentation Cable Schedule. Power cable, wire size and type shall be in accordance with NFPA 70 - 1999.

All wires and cables external to an enclosure shall be of the instrument tray cable (ITC) type, flame-retardant (passes IEEE 1202 vertical flame test), and have a 90 °C continuous rating in wet or dry locations. All cable insulation and jacket material shall be resistant to heat, moisture, impact, ozone, and meet or exceed the following requirements:

300 V rated for low voltage instrument cables (up to 120 VAC and 125 VDC)

600 V rated for power/motor control cables (up to 480 VAC and 250 VDC)

The wire insulation color for power wiring shall be of the following:

Black	Ungrounded conductors more than 50 VAC
White	Grounded conductors more than 50 VAC
Green	Equipment grounding wire
Green/Yellow tracer	Isolated instrument grounding wire
Light Blue	Ungrounded supply voltage less than 50 V (DC or AC)
Violet	Switched ungrounded voltage less than 50 V (DC or AC)
White/Blue tracer	Grounded or return supply voltage less than 50 V (DC or AC)

3.6.7 Accessibility and Maintenance

The enclosures shall be designed so that tools and test equipment may be used to accomplish all necessary adjustments, maintenance, cleaning, testing, and calibration. If specialized tools are needed for adjustments, maintenance, cleaning, testing, and calibration the Supplier shall provide two sets per order to Buyer upon delivery. Test points and calibration areas shall be accessible, clearly identified, and labeled. Adequate space shall be provided for removal and replacement of individual instruments or components located inside the enclosure. Equipment mounted in the rear of the enclosure shall be positioned to facilitate removal and replacement from the front of the enclosure.

3.6.8 Enclosure Nameplates, Labels, and Wire Markers

Where one end of the wire is provided by the original equipment manufacturer, connected to the component, in a pigtail configuration, and identifiable by other means such as color coding, only the

end of the pigtail that is provided un-terminated by the original equipment manufacturer is required to be identified by the mean described in this section.

The Buyer will provide the enclosure name, service description as detailed in section 8.1, and wire marker syntax and name/number.

External enclosure nameplate shall be constructed from 2-ply laminated plastic with white surface and black core. Letters shall be engraved through the white surface to the black core. Enclosure nameplate shall be engraved with the equipment tag number and a very brief service description. The nameplate shall be a minimum of 1/8 inch thick with beveled edges. The nameplates shall be attached to the enclosure either with an industrial adhesive appropriate for the tag and enclosure materials or by using stainless steel drive screws without violating the NEMA rating of the enclosure. The minimum character height for enclosure name/number shall be no less than 5/8 inch. The minimum character height for service description shall be no less than 1/4 inch.

Internal enclosure nameplates shall be provided for instruments, instrument accessories, switches, relays, terminal strips, lamps and equipment with a field wiring connection. Nameplates shall be visible from the front of the cabinet with the doors open. The nameplates shall be constructed from 3-ply laminated plastic with white surface and black core. Internal enclosure nameplates shall be attached using epoxy if it is compatible with the mating materials, causes no detrimental effects, and will not cause any structural damage. For a viewing distance of 3 feet, the minimum character height shall be no less than 1/8 inch.

Safety Labels shall not be attached to removable items that could be replaced in a different orientation.

Each wire shall be clearly identified with a wire marker at each end by means of heat shrinkable plastic sleeves or other Buyer approved permanent type wire marker in black text on white background. Open markers or "C" type sleeves that can be applied after a conductor is terminated will not be accepted. Minimum character size for wire marker shall be no less than 3/32 inch. The wire markers shall be attached within a maximum of 2 inches from the termination of the wire. Orientation of the wire marker shall be such that its identification is visible when viewed from the front of the enclosure looking in.

3.6.9 Human Factors

Controls, indicators, and the similar type devices shall be mounted between 36 and 70 inches above the floor.

3.7 Equipment Electrical Requirements

Refer to Attachment EKP0 for any additional electrical requirements.

3.7.2 Discrete Interfaces

The Supplier shall provide isolated, dry contacts where hardwired signals from controls or monitoring equipment on Supplier's packaged equipment is required by the Buyer's control system. The interfaces are distinct from control systems communications interfaces described in paragraph 3.4.

3.7.3 Analog or Continuous Signal Interfaces

The Supplier shall provide current loop isolators where a continuous signal in the Supplier's system is required to be monitored by the Buyer's control system.

3.7.4 Surge Protection

The Supplier shall provide surge protectors for solid-state equipment, if not inherent in the equipment design, to prevent damage from the effect of lightning strikes or other electrical transients.

3.7.5 Arc Suppression

The Supplier shall provide and install a suitable arc suppression device or kickback diode across switched loads unless the switching component includes inherent arc suppression. Kickback diodes shall be supplied and installed on all inductive DC loads.

3.7.6 Emergency Stop and Reset

All machinery Equipment Control Panels shall be provided with an emergency stop (E-stop) independent of software or electronic logic. Where physical injury is credible, E-stops will be provided local to the machine. In addition, where mechanical handling equipment is controlled remotely, E-stops shall be provided at such control points. In order to prevent a subsequent restart, while the dangerous condition exists, the emergency stop circuit shall remain in the shutdown state until the circuitry is reset.

For machinery equipment which has no communication with the Buyer's control system, the E-Stop circuits shall provide a local indication of the status of the E-Stop when activated. Local indication of E-Stop status may be provided by either a local indicating light and/or a physically depressed E-Stop button/switch.

Machinery equipment in communication with the Buyer's control system shall provide status of all E-Stop circuits which shall be individually monitored in the Buyer's control system. This will be achieved by additional contacts on the switch wired directly to the Buyer's control system. Contacts wired from motor control relays will not be accepted.

3.7.7 Conduit and cable

Exposed conduit for process power and instrumentation shall be rigid, galvanized steel (RGS) and supported with corrosive resistant hardware. As a minimum, single pair instrumentation cable shall be 18 AWG, multiple pair instrumentation cable shall be 20 AWG, and control and instrument power circuits (120 VAC/125 VDC) shall be 14 AWG.

3.7.7.3 Separation

AC power shall be routed through separate raceways or separated with a divider from 24 V DC discrete and analog instrument signals within enclosures. Power and signal cabling shall not be run in parallel, except in separate raceways or wireways, and should only cross at a 90-degree angle. This includes wiring to door mounted instruments contained in spiral wrap. A minimum of 1/4" separation shall be maintained between power & instrumentation / signal wiring.

Internal enclosure wiring shall be neatly dressed in slotted non-metallic wireways. The wireway shall be securely fastened to the enclosure back-panel. Non-metallic wireways shall be provided on the opposite sides of the field terminations to be used by the Buyer. Adequate space shall be provided around terminal blocks to allow the Buyer to install, route and terminate cables. The field side wireway shall be designed for multi-core field cables with a minimum conductor size of #14 AWG.

Circuits of different voltages (service level) shall be terminated on physically separate terminal strips and clearly labeled to show the circuit voltage. Terminal blocks shall be segregated according to signal type. If safety instrument system components are installed in an enclosure, the wiring shall be clearly identified and segregated from non-safety instrumentation systems.

Power supplies will be provided from separate sources for safety and non-safety instrument use. The Supplier shall design and provide a physically and electrically separate power supply distribution and circuitry, as required, for safety instrumentation systems and non-safety instrumentation systems in accordance with IEEE 384.

Instrumentation cables shall be terminated in separate junction boxes from the power and control cables.

3.7.8 Wire and Cable Markers

Where one end of the wire is provided by the original equipment manufacturer, connected to the component, in a pigtail configuration, and identifiable by other means such as color coding, only the end of the pigtail that is provided un-terminated by the original equipment manufacturer is required to be identified by the mean described in this section.

All Supplier provided wiring shall be identified at each end with a numbering system that is cross-referenced on all appropriate drawings. The wire-numbering scheme shall be proposed by the Supplier with the Buyer's concurrence. Ferrules or wire markers shall be indelibly and clearly marked in black on white plastic, heat shrinkable sleeves. Open markers or "C" type sleeves that can be applied after a conductor is terminated will not be accepted. Junction box (JB) terminals shall have adequate space between them and the JB internal walls so connected cables and individual wire numbers can be easily read without disturbing the wiring within the JBs.

All cables provided by the Supplier shall be clearly identified with a heat shrink type label.

3.8 Process Connections, Tubing and Instrument Mounting

3.8.1 Instrument Process Connections

The preferred orientation of process connections in horizontal piping is shown in Appendix A. The purpose, for all pipe runs for instrumentation use, is to avoid gas pockets in liquid and vapor sensing lines and to avoid liquid pockets in gas sensing lines. Sensing lines for gas measurements shall slope downward toward the process at least 1/4" per foot. Sensing lines for liquid shall slope downward toward the instrument at least 1/4" per foot. Measurement of pressure or flow in steam lines or condensable vapor lines shall be provided with condensate pots to ensure known liquid fill level in sensing lines.

Piping specifications are generally as required in the process piping section of the primary equipment specification. Pressure measurement connections shall be ¾ inch except where the process piping is ½ inch or less. If the process piping is ½ inch or less, the instrument connection shall be ½ inch. Instruments mounted in-line or tanks shall be installed per manufacturer's requirements. Welded process connections shall be socket or butt welded per the requirements of the piping specification in the primary equipment specification.

Generally provide connections on piping and vessels for instruments in accordance with the following:

Type of Measurement	Screwed	Socket Welded	Flanged
Analyzer	¾"	-	1 ½"
Flow			
Orifice Tap	½"	¾"	2"
Flow Tube Tap	¾"	¾"	2"
Level			
Differential Type			
Standard	½"	¾"	2"
Flange Mounted	-	-	3"
Ball Floated			
External Cage	1 ½"	1 ½"	1 ½"
Vessel Mounted	-	-	4"
Capacitance	1"	1"	3"
Radar	-	-	6"
Ultrasonic	1"	1"	3"
Purged Tube	½"	½"	6"
Bridle (Standpipe)	3"	3"	3"
Pressure			
Piping	¾"	¾"	-
Vessels	¾"	-	1 ½"
With Seals	-	-	3"
Temperature			
In Piping	1"	1"	1 ½"
In Vessels/Tanks	-	-	1 ½"

3.8.2 Instrument Isolation Valves at the Instrument

To allow isolation of pressure sensing instruments, each pressure-sensing instrument shall have a shutoff valve, or a 2-valve manifold for transmitters, that is close to the instrument and is readily accessible. The Supplier shall, however, provide bleed valves on direct connected pressure gauges and pressure switches. Individual isolation or bleed valves shall be Swagelok instrument ball valve series 40 or Buyer approved equal with either screwed or compression end fittings as appropriate. All remote mounted pressure instruments shall have an integral manifold (block and bleed). All differential pressure instruments shall have integral five valve manifolds. All instrument valve manifolds shall be of 316 SS construction with Viton O-ring seals unless otherwise specified in the primary equipment specification. Other materials shall be required depending on ambient radiation conditions. The Supplier shall propose alternate materials for instruments as appropriate for the Buyer's review and concurrence.

3.8.3 Thermowells

Thermowells shall be provided for each temperature sensor. Wake frequency calculation shall be performed using ASME PTC 19.3 to ensure that the velocity-induced frequency is not more than 80 percent of the critical frequency during all modes of operation. Protective tubes in lieu of thermowells are acceptable for HVAC air duct applications.

All thermowells shall have sufficient extension to preclude interference with process pipe or vessel lagging (insulation).

The following are standard thermowell length, insertion (U) length and Lagging (T) length proposed for the project:

A. Threaded Thermowells

Line Size	"U" Length	Stem Length	Remarks
≤ 2"	2 1/2"	4"	Line swage or elbolet installation
3" & 4"	4 1/2"	6"	Elbolet or latrolet installation
4"	2 1/2"	4"	
6 & 8"	4 1/2"	6"	
10 & 12"	7 1/2"	9"	
≥14"	10 1/2"	12"	

Insulation Thickness	"T" Length	Remarks
2" & less	None	
3"	3 1/2"	
4"	4 1/2"	
5"	5 1/2"	
6"	6 1/2"	

B. Flanged Thermowells

Line Size	"U" Length	Stem Length	Insulation Thickness
3"			See note below
4"			See note below
6"		9"	See note below
			See note below
		12"	See note below

Note: Approximately 6" clearance between the top of line and the top of well flange face available for insulation.

Thermowells shall not be installed in the minimum straight run of pipe, upstream or downstream of a flow element.

3.8.4 Sensing Tubing

Sensing lines shall be kept as short as possible and shall have a continuous slope to promote them being kept free of liquid, as appropriate. Slope shall be 1/4 inch per foot minimum. Slope instrument impulse lines toward the process to prevent the accumulation of condensable liquid in gas lines.

Tubing runs shall be properly supported in tube clamps or channel and protected from mechanical loads. Expansion bends shall be provided if necessary to allow for movement of supporting structures or change of length due to temperature caused expansion or contraction. Tubing runs shall not prevent access to equipment or instruments for operation or maintenance. Tubing bends will be provided to allow easy removal of instruments.

Use air or liquid purges, chemical seals, or other suitable means to ensure low maintenance, trouble-free operation for instruments in particulate and/or chemical service. Purges shall be provided such that purge velocity is greater than process velocity. Process leads filled with a special liquid shall not be used.

Tubing runs that can contain high temperature fluids shall be covered with insulation or screens where necessary for personnel protection. Prefabricated heat-tracing bundle is preferred for condensing gasses.

3.8.5 Pneumatic Supply and Signal Lines

Pneumatic piping and tubing shall be grouped and supported in parallel runs. Unless otherwise specified all pneumatic tubing shall be seamless 316 SS as a minimum. To facilitate installation by the Buyer at site, all incoming/outgoing air connections shall terminate at clearly identified bulkhead fittings. Instrument tubing shall be identified at the bulkhead terminal connection with a suitable tag indicating the instrument tag number or an identifier used on the Supplier's piping/tubing diagrams.

Where the Supplier requires instrument air, the Buyer's instrument air supply headers will be connected to the Supplier's package at one location. The Supplier shall provide filtration and pressure reduction as necessary for air utilization. Where pressure reduction is necessary, The Supplier shall provide two pressure regulators and two filters piped in parallel with the necessary valving to allow removal and maintenance of either regulator or either filter without impacting operation of the supplied equipment.

Provide isolation valves and calibration connections on impulse and pneumatic signal lines to permit in-place calibration. When two or more instruments or accessories are connected through fittings to the same bulkhead connection, needle type shutoff valves shall be located at each instrument or accessory.

Where pressure switches are provided as secondary devices for alarm initiation, a plugged tee shall be installed between the isolating valve and the switch to facilitate testing.

3.8.8 Instrument Location and Mounting

Instrument mounting locations shall be selected with consideration of both function operation and accessibility requirements for maintenance. Instrumentation should not be mounted on vibrating equipment or light duty support. Instruments shall not be mounted on handrails or safety railings. Instrument mounting bolting and hardware shall be 316 SS. Mounting brackets and stands for SS instrumentation shall be qualified to the seismic requirements specified by the primary equipment specification.

3.8.8.1 Operability Requirements

The location of pressure sensing instruments shall be selected to minimize the need for purged leads and special seals to achieve satisfactory operation.

3.8.8.2 Accessibility Requirements

Each instrument shall be installed so as to allow adequate safe access for both operation and maintenance.

4 Materials

4.1 General

Selection of material shall be based on fluid properties, environmental conditions, or as specified on the primary equipment specification and/or material requisition, to which this specification is attached.

4.1.1 Instrument Impulse Tubing and Tube Fitting

Instrument impulse lines shall generally be 3/8 inch OD x 0.035 inch wall, seamless, annealed, ASTM A269, Grade TP316 SS with a carbon content of less than 0.03% and an RB80 hardness. Instrument tubing shall be marked in accordance with the ASTM material specification, which shall indicate as a minimum, the type and grade of material.

All compression fittings shall be machined or forged from 316 SS with carbon content less than 0.03% or 316L SS. Other tube fitting materials may be used (with Buyer's approval) as required for the service applications and the environmental conditions. All tube compression fittings shall be of the two ferrule, flareless design, gageable, and maintain a leak tight connection after 20 remakes (minimum) per fitting manufacturer's remake instructions on any recommended tubing. All components of the fitting shall carry the manufacturer's name and trademark. The Supplier shall only supply tube fittings from one product line of a single manufacturer. Materials for flareless compression type stainless steel tube fittings shall be ASTM A182 for forgings and ASTM A276 for parts machined from bar stock.

Tubing within radiation areas such as process cells or canyons shall be fusion welded and fabricated from 316L SS. Any tubing fittings within these process cells or canyons shall be butt welded tube fittings fabricated from 316L SS.

Manufacturers of tube and fittings shall also have tubing and fittings available in 316 stainless steel, Alloy 400, Alloy 20, Alloy C-276, Alloy 600, titanium, and carbon steel.

4.1.2 Instrument Manifold Valves

Integral 2-valve manifolds shall be supplied with pressure transmitters. Integral 5-valve manifolds shall be supplied with differential pressure transmitters. The manifolds shall be fabricated of 316 SS. These manifolds shall be manufactured by Anderson Greenwood or Buyer approved equal.

4.1.3 Enclosures, Panels, Cabinets, and Racks

In areas where radioactive contamination is likely, only stainless steel enclosures, panels, and cabinets shall be used.

The Rack structural components and all mounting material shall be constructed entirely with stainless steel. This includes bolts, nuts, washers, screws, retainer springs, and clips.

4.2 Prohibited Materials

Mercury containing instruments or devices such as mercury wetted switch contacts; mercury thermometers or capillary systems using mercury shall not be used.

4.3 Special Requirements

Where a conduit enters a junction box, a bushing shall be provided to protect the wire insulation from damage due to sharp metal edges.

4.4 Painting Requirements

In general, instrument manufacturer's standard painting color and finish shall apply. However, Supplier shall also follow the project Shop applied special protective coating as required by the parent specification.

4.5 Storage of Special Materials

The Supplier shall cover or plug all openings on equipment, tubes, pipes, and instruments prior to shipment and/or for storage.

5 Fabrication

Platforms, ladders, or other means of access shall be provided for instrumentation or components that require maintenance or adjustment which are not accessible from a floor or a major structure.

8 Identification

8.1 Nameplate

Each instrument shall have nameplate information that includes following:

Applicable to ALL Instrumentation

- Manufacturer's Name
- Manufacturer's model and serial number
- Buyer's Purchase Order No.
- Buyer's Item No.
- Buyer's Tag Number

Applicable to PROCESS Instrumentation

- Nominal Pipe size, inches
- Body material
- Size
- Minimum and Maximum flowrate
- Meter Factor
- Pressure and Temperature rating
- Flow direction arrow and/or words IN and OUT on the piping connections

Applicable to ELECTRONIC Components

- Power rating
- Electrical Area Classification
- Approvals and Listings per NEC

Where the combination of manufacturer's standard nameplate and instrument body stampings are unable to accommodate all of the required and applicable information, a separate stainless steel nameplate shall be provided to include the Buyer's tag number, PO number, and all of the applicable missing information. This separate stainless steel nameplate shall have the information impressed, stamped, or etched directly on the stainless steel surface. The nameplate, where physically possible, shall be secured to the body of the instrument by corrosion resistant screws tapped into a low stress area of the assembly, so the structural integrity and functional capability of the assembly are not impaired. If it is not physically possible to secure the nameplate to the body of the instrument, then the nameplate shall be attached using a stainless steel wire.

8.2 Panel Mounted Instrument Nameplate

In addition to the nameplate requirements for instruments, each panel mounted instrument shall be identified by tag number (Buyer provided tag number) engraved as specified in section 3.6.8. Letter shall be a minimum of 1/8 inch in height. Nameplates shall be attached as specified in section 3.6.8.

10 Training

Then Supplier shall include training courses and durations as required to train the Buyer's engineering, maintenance and operation personnel in system overview, system architecture, hardware maintenance, software engineering, software maintenance, operation, troubleshooting, etc. for the supplied instrumentation system.

11 Documentation and Submittals

Refer to Part 2, Drawings and Data Requirements of the Material Requisition to which this specification is attached and the following for specific requirement of each instrument.

11.1 Instrument Tagging

Instrument tag numbers will be assigned and provided by the Buyer to the Supplier. The Supplier shall incorporate these tag numbers into the design documents and shall comply with instrument identification requirements.

11.2 Drawings and Data

11.2.1 Instrument Data Sheets

Process instrument data sheet forms will be supplied for some equipment by the Buyer and shall be completed by the Supplier for field mounted process instrumentation.

11.2.2 Instrument List

The Supplier shall provide an equipment instrument list, which lists each instrument and is arranged in numerical order. The fields required are as follows:

- Instrument tag number
- Supplier's referenced tag number if applicable
- Service description
- Instrument type
- Signal type
- P&ID number
- Data sheet number
- Location drawing number
- Instrument installation details
- Manufacturer name
- Model number
- Calibration range of instrument
- Set point
- Wiring diagram number
- Schematic drawing number
- Device address of serial communication link data
- I/O address of serial communication link data
- Shipped loose

In addition, where applicable, a separate list of instruments designated as Safety Significant shall be maintained and provided. See Section 3.1.14 for detailed information.

The list shall include:

The performance specifications for normal operation and under conditions existing during and following accidents.

The load, pressure, voltage, frequency, and other characteristics, as appropriate, for which the performance specified can be ensured.

11.2.3 Panel, Cabinet, Enclosure Outline and Dimensional Drawings

Outline and dimensional drawings shall show the size and location of electrical, pneumatic and service connections and information necessary to locate and mount the equipment, if it is to be mounted by the Buyer.

A dimensional layout drawing shall show the location of electrical and control equipment. This drawing will include the dimensioned outline of the required electrical working space boundary around electrical and control enclosures. Electrical and control equipment enclosures shall be installed so that they comply with NFPA 70-1999, section 110-26 and sections 110-32 through 110-34. Include the working space boundary required for all outward facing (facing out from the skid) electrical and control enclosures.

The outline and dimensional drawings shall also include the enclosure weights and approximate location of the enclosure center of gravity with all instruments and components installed. This drawing or a separate drawing shall include dimensional and material information for the enclosure base, including bolt location and size for permanent attachment of the enclosure(s) to the building structure.

Outline and dimensional drawings shall be provided for all instruments shipped loose for Buyer's installation. The drawing shall include the instrument tag number.

11.2.4 Installation Details

Deleted

11.2.5 Wiring Diagrams

Point to point wiring diagrams provided by the Supplier shall include, but not be limited to the following features:

- Identify all devices with the Buyer's tag numbers, where applicable
- Identify grounding method for incoming cable shields
- Be relative to the equipment or panel terminals
- Show devices and their terminals in relative location
- Include contact developments for control switches, pushbuttons and relays.

11.2.6 Electrical Schematics

Schematics shall be provided for all motor controls. Motor Control Center interfaces with Supplier's provided motors shall be clearly shown with all wiring interfaces shown in schematic form.

11.2.7 Instrument Loop Diagrams

Loop diagrams depicting the wiring between components of electronic analog loops and discrete (on/off) loops shall be provided. These drawings shall contain, as a minimum all the information required by ISA S5.4 Figure 3 with notes and drawing references. The interface between Supplier's and Buyer's equipment, wiring and instruments shall be shown in detail, including terminal and wire identification. Electronic loop diagrams shall show Supplier's grounding and shielding provisions.

In the case of bussed network instruments, network segment drawings shall be provided in lieu of loop diagrams.

11.2.8 Pneumatic Piping or Interconnection Diagram

Diagrams depicting the signal tubing and air source interconnections between pneumatic devices shall be provided. The interface between the Supplier's and the Buyer's devices and air source shall be shown in detail.

11.2.9 Control Diagrams

Control diagrams consisting of schematics showing the equipment functional controls shall be provided for the Buyer's review. These drawings shall show in detail all the control circuits and the their relationship with other components within the Supplier's package and the interface between the Buyer and Supplier provided controls. If the Buyer is to implement the Supplier's control on a Buyer provided control system, the controls necessary to operate the Supplier's equipment will be based upon these drawings.

11.2.10 Software Documents

Documentation as defined within this specification shall be provided. These will be used for the design development, quality assurance, verification review, approval, and validation testing of all the software supplied by the Supplier and/or its subcontractor. They shall be in accordance with all the requirements depicted in this specification and industrial standards.

11.2.11 Cable Block Diagrams

Cable Block diagrams shall identify the relationship of all cabling with cable numbers that interconnect between panels, junction boxes and components. These diagrams shall identify the size and number of conductors in each cable. Preliminary versions of these diagrams shall be made available for 50% design review. The formal submittal shall be submitted prior to fabrication. Cables that will be provided and installed by the Buyer will be identified on the cable block diagram. The Supplier shall identify at the 50% design review the equipment breakdown for shipping that identifies those cables that need disconnecting for shipment. The Buyer will provide tag numbers for all junction boxes and panels that the Buyer has to terminate to.

11.2.12 Manufacturer's Technical Literature

The Supplier shall provide manufacturer's technical literature for all technical components and instrumentation provided within the Supplier's package.

11.3 Procedures

11.3.1 Site Storage and Handling Procedure

The Supplier shall provide site storage and handling procedures in accordance with Part 2 of the Material Requisition to which this specification is attached. Procedures shall be issued to the Buyer nine-months prior to shipment. One copy of the procedure shall be attached to each shipping container. The Supplier is responsible for stipulating any site storage requirements necessary to maintain any implied or stated equipment warranty including shelf life for spare parts. Refer to Engineering Specifications for Packaging, Handling, and Storage Requirements, 24590-WTP-3PS-G000-T0003 for additional requirements.

11.3.2 Functional Test Procedure

The Supplier shall submit equipment functional test procedures that will be used to demonstrate to the Buyer's satisfaction that the equipment will function in accordance with the specified requirements. Procedures shall be submitted for the Buyer's review in accordance with the Part 2 of the Material Requisition to which this specification is attached. Procedures shall be submitted at

least one month prior to scheduled performance of the functional demonstration to be witnessed by the Buyer's engineer(s). Scope of these tests shall be agreed to between the Buyer and Supplier via review of the proposed test procedure.

The functional test procedure shall include:

- Requirements for maintaining records of functional tests
- Description of method used to track status of testing
- Requirements for inspection prior to testing to determine test readiness
- Procedures for documenting failures and errors encountered
- Procedures for documenting agreed test modifications or procedure corrections deemed necessary to resolve a test finding
- Method of documenting final resolution of test anomalies
- Acceptance criteria

11.3.3 Operating, Startup and Shutdown Procedures

The Supplier shall provide procedures in hard copy as well as in electronic describing the method of starting, operating and shutting down the equipment package.

11.4 Calculations

Calculations shall be submitted for the Buyer's verification as indicated in Part 2, Drawings and Data Requirements, in the Material Requisition to which this specification is attached. Calculations shall be orderly, complete, and sufficiently clear to permit verification.

The body of the calculation shall include:

- A concise statement of the purpose of the calculation
- Input data, applicable criteria, and stated assumptions
- A list of references used, including drawings, codes, standards, and computer programs, indicate the version or issue date
- A discussion of the rationale used for design assumption basis
- Equations used for all computations
- Numerical calculations, including identification of units used
- A concise statement addressing the calculation results and/or recommendations
- A table of contents for complex calculations.

11.4.1 Electrical Load

The Supplier shall submit calculations showing the electrical power consumption, both peak and continuous for each power voltage level required by the Supplier to operate all equipment and instruments provided.

11.4.2 Heat Loads

The Supplier shall submit a list of all calculated and estimated control panel/cabinet heat loads.

11.4.3 Instrument and Service Air Consumption

The Supplier shall submit calculations showing the instrument and service air consumption both peak and continuous. The submittal shall identify instrument and service air consumption separately.

11.4.4 Sizing Calculations

The Supplier shall provide, for review and approval, the sizing calculations used to size modulating control valves per ISA S75.01, head producing flow elements, and pressure relieving devices per API RP 520 PT I.

11.5 Manuals

Operation and maintenance (O&M) manuals in both hard copy and electronic form shall be provided for the equipment package. The O&M manual shall include startup, operating and shutdown procedures as well as periodic and preventative maintenance procedures. The requirements for the package O&M manuals are contained in the Material Requisition.

11.6 Schedules

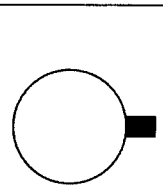
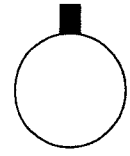
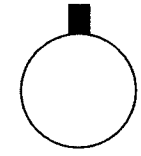
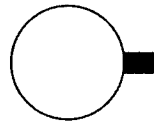
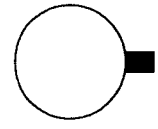
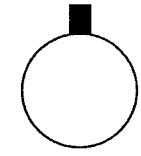
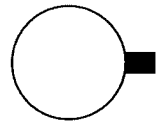
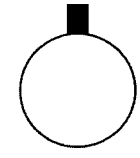
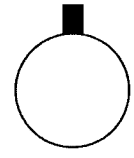
11.6.1 Material Schedule

A schedule of material listing all instruments and devices to be located on or supplied with the equipment package shall be provided. The schedule or bill of material shall contain the Buyer's tag numbers where applicable, manufacturer, model number, part number, description, quantity and brief material description.

11.6.2 Spare Parts List

The Supplier shall submit a recommended spare parts list covering all items within the Supplier's scope. The spare parts recommendation shall be based upon Supplier's experience with component failure, maintenance requirements, environmental conditions, as well as consideration of the total quantities of each device supplied by the Supplier. The Supplier's recommendation shall include both construction/commissioning and operating spares. Construction/commissioning spare parts are those parts to be held for use during construction, testing, and commissioning. Operating spare parts are those to be held for the first year of operation of the plant.

APPENDIX A-1 Sensing Line Process Connection Orientation

MEASURED VARIABLE	LINE FLUID: LIQUID	LINE FLUID: STEAM VAPOR OR SLURRY	LINE FLUID: AIR OR GAS
FLOW			
PRESSURE OR DIFFERENTIAL PRESSURE			
ANALYSIS	LIQUID: 	STEAM, VAPOR, AIR, OR GAS: 	
TEMPERATURE	ALL FLUIDS: NOTE: THIS ORIENTATION FOR TEMPERATURE INSTRUMENTS WILL NOT APPLY IF THE PIPE DIAMETER IS SMALL AND REQUIRES A TEE OR ELBOW TO BE USED. 	**INSTRUMENTATION: MEASURED VARIABLE TAPPING POINTS ORIENTATION**	

ATTACHMENT EKP0

LAW TCO CUSTOMIZED EKP0

Per 24590-WTP-3PS-EKP0-T0001, Rev. 5
ENGINEERING SPECIFICATION FOR ELECTRICAL REQUIREMENTS FOR PACKAGE SYSTEMS

This attachment defines the requirements for electrical equipment, materials and installation associated with the Low Activity Waste Thermal Catalytic Oxidizer/Reducer (LAW TCO), which are provided as manufacturer standard or custom design and pre-assembled units, in accordance with the National Codes and Industry Standards. For continuity, the section numbers from the specification noted above have been retained.

1.7 Work by Others

1.7.3 Power Supply

The Buyer will provide normal power and/or Uninterruptible Power Supply (UPS) for the Supplier's instruments unless otherwise specified on the parent specification. Each source will be delivered at 120 VAC, single phase, 60 Hz, grounded system. 480 VAC, 3 phase, 60 Hz power will be provided as required for motors. All other voltages required by the Supplier shall be derived from the Buyer provided 120 VAC or 480 VAC.

2.0 Criteria for Acceptability of Electrical Equipment

- All electrical equipment for facility and equipment wiring, as defined by the National Electrical Code NFPA 70-1999, shall be Approved. Approval will be in accordance with Article 90-4, "Enforcements", Article 90-7, "Examination of Equipment for Safety," and Article 110-3, "Examination, Identification, Installation, and Use of Equipment."
- Approved means "Acceptable to the Authority Having Jurisdiction" (AHJ), as defined in Article 100 of NFPA 70-1999. Only the WTP Electrical AHJ can provide the approval.
- "Equipment" is defined by the NFPA 70 as, "A general term including material, fittings, devices, appliances, fixtures, apparatus, and the like used as a part of, or in connection with an electrical installation". As used here, the entire mechanical assembly is not considered an electrical installation, only the electrical and/or electronic components, and the interconnecting wiring.
- Listing and labeling by an OSHA Nationally Recognized Testing Laboratory (NRTL) is the primary means (Method 1 below) of obtaining WTP AHJ approval for electrical equipment, devices and materials.
- All Control Panels shall be UL labeled by a certified UL 508A shop.
- Electrical Equipment that is installed on (standard or custom fabricated) Mechanical Equipment shall comply with the requirements stated above.
- Electrical Equipment, that is part of Mechanical Packaged Equipment, where the entire mechanical skid is field-evaluated and Labeled at the factory by an NRTL is an alternate method of obtaining WTP AHJ approval.

2.1 Method 1 (Primary): Listed, Labeled or Certified (i.e. UL508A)

2.1.1 The WTP AHJ shall approve and accept electrical equipment without additional examination if it is Listed, Labeled, or Certified by a US NRTL, as recognized by OSHA under 29 CFR 1910-Subpart S and is acceptable for the application, environment and other requirements of NEC Article 110. For a listing of and Typical Registered Certification Marks of US NRTL's recognized by OSHA go to http://www.osha.gov/dts/otpca/nrtl/nrtlmrk.html.

2.2 Method 2 (Alternate): Field Evaluation by a NRTL

2.2.1 Electrical equipment that is part of an overall electrical or mechanical assembly having a NRTL safety evaluation or a field evaluation, which states the equipment has been accepted or otherwise deemed safe by the NRTL recognized by OSHA under 29 CFR 1910-Subpart S, using US standards, will be evaluated by the WTP AHJ for acceptability. If found acceptable no further examination of the equipment is required. The Supplier shall submit the NRTL safety/field evaluation report, or evidence of compliant labeling/listing of electrical equipment including UL 508A certification/labeling of control panels for the Buyer's Electrical AHJ review and approval prior to having the equipment released for shipment.

2.2.2 The Supplier shall submit all field evaluation reports completed by an OSHA recognized NRTL to the Buyer for review and approval by the AHJ. These field evaluation reports shall show compliance to the applicable USA Electrical Standard(s) recognized by OSHA that are listed on the OSHA website http://www.osha.gov/dts/otpca/nrtl/allstds.html. The NRTL Label will be as shown on the OSHA website with whatever additional markings that are necessary to indicate acceptability for use in the USA http://www.osha.gov/dts/otpca/nrtl/nrtlmrk.html.

2.2.3 The Supplier shall submit a Certificate of Compliance (C of C) document for review and approval by the AHJ that lists the USA Electrical Standard(s) that each electrical material or equipment is evaluated to for it's NRTL Listing. Only those standards that are listed on the OSHA website http://www.osha.gov/dts/otpca/nrtl/allstds.html are acceptable to the AHJ. The certification shall confirm that the NRTL Label for each electrical component will be as shown on the OSHA website including the additional markings required to indicate acceptability for use in the USA http://www.osha.gov/dts/otpca/nrtl/nrtlmrk.html.

2.3 If the Supplier is unable to meet the criteria in Method 1 or Method 2, the Supplier shall request in writing a variance by the Buyer's Electrical AHJ.

3.0 Applicable Documents

3.1 Codes and Standards

The equipment and installation shall conform to the applicable sections of the following National Codes and Industry Standards:

29 CFR 1910,	Occupational Safety and Health Standards, Electrical Sub part S
NFPA 70-1999	National Electric Code (NEC)
ANSI C80.1	Rigid Steel Conduit – Zinc Coated (GRC)
IEEE 383-1974	Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations *(Only Section 2.5 - Flame Tests, shall be applicable.)*
IEEE 515	Standard for Testing, Design, Installation and Maintenance of Electric Resistance Heat Tracing for Industrial Applications

IEEE 1202	Standard for Flame Testing of Cables for Use in Cable Tray in Industrial and Commercial Occupancies
NEMA ICS-1	Industrial Control and Systems General Requirements
NEMA ICS 6	Enclosures for Industrial Controls and Systems
NEMA RN1	Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metallic Conduit
UL 6	Standard for Safety Electrical Rigid Metal Conduit - Steel
UL 6A	Standard for Safety for Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel
UL 13	Standard for Power-Limited Circuit Cables
UL 2250	Standard for Safety Instrumentation Tray Cable
UL 44	Standard for Safety Thermoset Insulated Wires and Cables
UL 360	Standard for Safety Liquid Tight Flexible Steel Conduit
UL 508	Standard for Safety Industrial Control Equipment (17th Edition)
UL 514B	Standard for Safety Conduit, Tubing, and Cable Fittings
UL 1581	Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords
UL 1666	Safety Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
NEMA WC 55	Instrumentation Cables and Thermocouple Wire - ICEA S-82-552
NEMA WC 57	Standard for Control Cables - ICEA S-73-532
NEMA WC 70	Non-shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy - ICEA S-95-658
NFPA 262-2002	Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces

3.2 WTP Project Specifications

24590-WTP-3PS-JQ00-T0004 Management of Supplier Software

3.3 Nuclear Standards for Equipment Classified as Q

In addition to the above, when required for complying with the nuclear standards for SC and SS equipment or components, the Supplier shall follow the version as called out in this specification.

Deleted	
IEEE 383-1974	Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations
Deleted	
IEEE 1023-1988	Guide for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations
ASME NQA-1	Quality Assurance Program Requirements for Nuclear Facilities -2000 (not applicable to this LAW TCO procurement)

3.4 Reference Documents/Drawings

Specification	Title
24590-WTP-3PS-MUMI-T0001 *(As applicable)*	Engineering Specification for Medium Voltage Induction Motors
24590-WTP-3PS-MUMI-T0002	Engineering Specification for Low Voltage Induction Motors
24590-WTP-3PS-EVV1-T0001 *(As applicable)*	Engineering Specification for Low Voltage Adjustable Speed Drives
Addendum JQ07	Engineering Addendum for Instrumentation for Package Systems
24590-WTP-3PS-JQ06-T0005 *(As applicable)*	Engineering Specification for Environmental Qualification of Control and Electrical Systems and Components

4.0 Design Requirements

•4.1 General

4.1.1 The Buyer will provide electrical service at the following voltages for Supplier's system, as applicable.

4.1.1.1 Medium voltage:

••13.8 kV, 60 Hz, 3 phase, 3 wire, low resistance grounded neutral, with the ground fault current limited to 2000 amps.

4.1.1.2 Low voltage:

••480 V, 60 Hz, 3 phase, 3 wire, solidly grounded

••208 V / 120 V, 60 Hz, 3 phase, 4 wire, solidly grounded

••120 V AC, 60 Hz, 1 phase UPS

5.0 Construction

•5.1 Motor Starters and Control

Unless otherwise stated in the primary specification, motor starters for 460 V, 3 phase motors ½ Hp and larger will be provided by the Buyer and installed remotely from the packaged unit. However, special consideration will be given to packages in which the provision of motor starters by the Supplier may be beneficial. When furnished with the packaged unit, the starters shall have the following configuration. Starter units with electronic overload shall only be used for Non-Safety applications. Electromechanical starters can be furnished for both Non-Safety and Safety applications.

5.1.1 Motor Starters with Electronic Overload

5.1.1.1 Motor starters with electronic overload protection can be supplied for SSCs classified as RRC, or Non-Safety, (i.e. CM quality level). (Note: Siemen # Simocode 3UF50 protection device is used in the Buyer's MCCs and is preferred.)

5.1.1.2 Combination starters shall be equipped with a pad-lockable disconnecting means, a magnetic contactor, a dedicated control power transformer (CPT), and a motor overload protection device.

5.1.1.3 Control panels with multiple starters may have a common disconnecting means and CPT.

5.1.1.4 When the motor control is designed for local and remote modes of operation, local controls shall be operable from the starter or control panel door, and remote control signals will be provided through the Buyer's communication network.

5.1.1.5 When furnished, the following local controls shall be available at the starter or control panel door:

1. Start/Stop function (pushbuttons or selector switch)
2. Local/remote selector switch (when local/remote mode is specified)
3. Trip reset
4. Indicating LED for Status (Green - motor stopped, Red - motor running, Amber - motor tripped)

5.1.1.6 When furnished, the electronic overload protection shall include the following features available for remote mode operation through the Buyer's communication network:

1. Start/Stop capability
2. Trip reset
3. Status indication (motor stopped, run and tripped)
4. Current monitoring of all three phases
5. Programmable parameters for the protective functions
6. Diagnostic information
7. Control voltage status
8. Other functions if available in the relay
9. Communication port to interface with the Buyer's Profibus communication network

5.1.2 Motor Starters with Thermal Overload Relay

5.1.2.1 Motor starters with thermal overload relays shall be supplied for SSCs classified as SC or SS, (i.e. QL-1 or QL-2 quality level). The Supplier may also provide thermal overload relays for SSCs classified as Non-Safety upon the Buyer's approval.

5.1.2.2 Each motor starter unit shall consist of a pad-lockable disconnecting means, a dedicated control power transformer (CPT), and a magnetic contactor with thermal overload relay including, but not limited to the following features:

1. Start/Stop function (pushbuttons)
2. Local/remote selector switch (when local/remote mode is specified)
3. Thermal overload relay (Class 20)
4. Trip Reset
5. Indicating LED for Status (Green - motor stopped, Red - motor running, Amber - motor tripped)
6. Two sets of contacts for the remote position of the selector switch shall be wired to terminal blocks for the Buyer's use
7. Spare main contactor auxiliary dry contacts (1 NO, 1 NC minimum) wired to terminal blocks for the Buyer's use

8. Auxiliary contact (1 NC) of overload relay shall be wired to terminal blocks for the Buyer's use.

9. Terminal blocks with approximately 20% spare terminals.

5.1.3 Space Heater

Where motors are supplied with space heaters, the CPT shall be sized to be the power source, and a dedicated control contact for the heater shall be provided and wired.

5.1.4 Local Disconnects

Where required, local disconnecting means shall be provided in accordance with section 430-102 and 430-113 of NFPA 70-1999.

5.1.5 Emergency Stop and Reset

Control panel for operating machinery shall be provided with an emergency stop (E-stop). Local emergency stop push buttons shall be provided on equipment where physical injury is credible. The emergency stop push button shall be readily identifiable and when depressed, shall remain depressed until it is manually reset. A spare contact shall be available for the Buyer's use. Emergency stop shall be hard-wired to the motor controller.

5.3 Power Protection and Disconnecting Means

5.3.1 Disconnecting means

Enclosures with incoming power supply shall have a manually actuated disconnecting means mounted on or close to the enclosure in an easily accessible location.

5.3.2 Overcurrent Protection

Devices in panels utilizing power shall have suitable overcurrent protection. Power shall not be "daisy chained" from device to device; however, bridge or comb jumpers may be used on the supply side of the circuit breaker or a fuse block.

5.5 Cables and Wiring

5.5.1 The Supplier shall mount, connect and wire each instrument or control device such that adjustment, maintenance, removal and replacement may be accomplished in a safe manner without interruption of service to adjacent but non-associated equipment, and without placing undue stress on installed wiring or devices. Accommodations for strain relief shall be made when routing wire to hinged enclosure doors and shall be wrapped with spiral wire wrap.

5.5.2 Other than the special cables furnished by the Supplier, cables shall be in accordance with the following:

a) Low voltage power and control cables shall be stranded copper, 600 V type XHHW-2 or Buyer-approved equivalent.

b) Internal wiring shall be stranded copper, flame-retardant, 600 V, synthetic heat resistant (SIS), or machine tool wire (MTW), or high-flexible thermoset.

c) The minimum size of conductor will be as follows (not including cabling integral to components):

Duty	External Conductor Size (AWG)	Internal Wiring in enclosures Size (AWG)
Power and Lighting (480 V and below only)	12	14

Current Transformer Wiring	10	10
Control Circuits (120 V AC / 125 V DC) and Instrument power circuits	14	16

5.5.3 Inter-connecting wiring or cabling for packaged units furnished by the Supplier, shall be terminated and tested according to this specification.

5.5.3.1 No more than two wires shall be connected to one terminal point if rated for more than one wire. Internal wiring shall be continuous from terminal to terminal without splices (except devices with pig tails). Bridge or comb jumpers are preferred to wire jumpers on terminal strips. Jumpers shall not be installed on field side of the terminal strip.

5.5.3.3 Circuits of different voltages (service level) shall be terminated on physically separate terminal strips and clearly labeled to show the circuit voltage. Terminal blocks shall be segregated according to signal type. In the event safety instrument system components are included in an enclosure, the wiring shall be clearly identified and segregated from non-safety instrument system circuits.

5.5.3.4 AC power shall be routed through separate wireways or separated with a divider from 24 VDC discrete and analog instrument signals within enclosures. Power and signal cabling shall not be run in parallel, except in separate wireways, and should cross at a 90-degree angle only.

5.5.3.5 Wires shall be tagged with the Supplier's cable designation number at both ends with (heat shrinkable or non-shrinkable) plastic sleeve type wire markers.

5.5.4 The Supplier shall furnish terminal boxes or control panels as follows:

5.5.4.1 Instrumentation cables shall be terminated in separate junction boxes from the power and control cables.

5.5.4.2 Where cables supplied and installed by the Buyer are run to the package unit, the Supplier shall provide space for installing and terminating the cables.

5.5.4.3 Approximately 25% of spare terminals shall be included in the terminal blocks.

5.5.5. Wiring for electronic, instrument, communication and signal cables shall be segregated from both power and control cables.

5.5.6 Terminal blocks shall be selected to accommodate the function and electrical requirements associated with each wiring application. They shall incorporate the following features:

a) Screw clamp wire connection
b) Single level configuration
c) Integral test points
d) DIN-rail mounted

5.6 Raceway System

5.6.1 Conduit System

5.6.1.1 Wiring shall be installed in metal conduit. Minimum conduit size shall be ¾ inch. ½ inch conduit is allowed when connecting to devices with ½ inch hubs.

5.6.1.2 Liquid-tight flexible metallic conduit shall preferably be used to isolate the transmission of vibration to the conduit system, and for connection to equipment which may be periodically removed.

5.6.1.3 Liquid-tight flexible metallic conduit shall be supported within 12 inches of each box, cabinet, conduit body, or other conduit termination and shall be secured at intervals not to exceed 4½ ft.

5.6.1.5 Conduit connections to junction boxes shall be made using watertight threaded hubs or factory threaded hubs.

5.6.4 Enclosures shall be designed for front access only unless otherwise specified. All components and equipment in enclosure shall be accessible and removable from the front. Enclosures shall be suitably rated for the environment specified.

5.7 Grounding

5.7.1 Non-current carrying metallic parts of electrical equipment shall be bonded together and made electrically continuous. Two grounding pads shall be furnished at diagonally opposite corners at the edge of skids for connection by the Buyer to the area ground grid.

5.7.2 Electrical equipment on the packaged unit shall be bonded to the package unit skid.

9.0 Documentation and Submittals

- **9.1 General**

The Supplier shall furnish the following documents as per form G-321E and G-321V in the subcontract or primary mechanical packaged equipment material requisition or purchase order (all drawings and data shall be in U.S. units):

9.1.1 Functional description of the electrical operation of the package.

9.1.2 Overall Single line diagram showing all electrical equipment.

9.1.3 Overall layout showing location of electrical items.

9.1.4 Interconnection diagram and cable schedule showing details of all internal connections and Buyer external connections. The Supplier's furnished cable schedule shall include service voltage and Class of Circuit per NEC Articles 725, 760 and 800 for each cable.

9.1.5 Individual equipment schematic diagrams, wiring diagrams, general arrangement drawings, foundation details and junction/terminal box details.

9.1.6 Material list with specific model number, manufacturer and catalogue cut sheets shall be submitted as part of the product data.

9.1.7 The SELLER shall include a list of all the electrical loads in the package, their individual consumption (in kW) and voltage level (in volts).

9.1.8 Recommended Spare Parts List

9.1.8.1 The Supplier shall provide a list of recommended spare parts as follows:

a) Startup/warranty spare parts – are those parts that may be required at any time during equipment installation, startup, testing and unit operation through the warranty period.

b) Operational spare parts – are those parts that required replacement at regular intervals to maintain continuous operation of the supplied equipment and/or system.

c) Capital spare parts – are major parts or equipment that provide reliable equipment operation throughout the plant life and having a significant lead time for manufacturer and delivery.

9.1.8.2 The spare parts list shall include pricing and delivery information valid for one year after delivery of the equipment.

9.1.9 Test reports as required by the primary specification.

9.1.10 In addition to the above, when required for complying with the nuclear standards for SS equipment or components, the Supplier shall submit the qualification documentation as required by the primary specification, material requisition and purchase order.

ATTACHMENT NN00

LAW TCO CUSTOMIZED NN00

Per 24590-WTP-3PS-NN00-T0001, Rev. 2
ENGINEERING SPECIFICATION FOR THERMAL INSULATION FOR MECHANICAL SYSTEMS

This attachment defines the minimum thermal insulation requirements for piping and mechanical equipment associated with the Low Activity Waste Thermal Catalytic Oxidizer/Reducer (LAW TCO) where insulation is specified on drawings, specifications, data sheets, and associated lists. This attachment does not address insulation that is designated as "Safety" or quality level 1 or 2, nor does it cover proprietary tank insulation systems, cryogenic insulation systems, or the insulation of furnaces and buildings. For continuity and maintaining configuration control, the section numbers from the specification noted above have been retained.

1.3 Material and Services Required

SELLER shall provide all insulation materials with associated cements, compounds, jacketing, fasteners/securements, personnel protection guards, and other necessary items for complete insulation systems as defined herein, as well as all services necessary for complete installation of insulation on piping and equipment identified on specified drawings, specifications, data sheets, and lists.

1.4 Conflicts

Instructions on specified equipment drawings and piping isometric drawings, including notes, shall supersede any conflicting requirements of this specification. At the time of quotation, the BUYER shall be notified of all conflicts between this specification and any other documents such as the referenced codes and standards, P&ID, or other procurement documents. Discrepancies, errors, or omissions shall be resolved in writing with the BUYER before the work is started.

2.0 Applicable Documents

Work shall be done in accordance with the referenced codes, standards, and documents listed below, which are an integral part of this specification. When specific chapters, sections, parts, or paragraphs are listed following code, industry standard, or reference document, only those chapters, sections, parts, or paragraphs of the document are applicable and shall be applied. If a date or revision is not listed, the latest issue, including addenda, at the time of Request for Quote (RFQ) shall apply. When more than one code, standard, or referenced document covers the same topic, the requirements for all must be met with the most stringent governing.

2.1 American Society for Testing and Materials (ASTM)

A 240 Standard Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

B 209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

C 167 Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations

C 195 Standard Specification for Mineral Fiber Thermal Insulating Cement

C 302 Standard Test Methods for Density of Preformed Pipe Covering Type Insulation

C 303 Standard Test Method for Density of Preformed Block-Type Thermal Insulation

C 449 Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement

C 533 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

C 547 Standard Specification for Mineral Fiber Pipe Insulation

C 552 Standard Specification for Cellular Glass Thermal Insulation

C 585 Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing

C 592 Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered)(Industrial Type)

C 610 Standard Specification for Expanded Perlite Block and Pipe Thermal Insulation

C 612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation

C 692 Standard Test Method of Evaluating the Influence of Wicking-Type Thermal Insulations on the Stress Corrosion Cracking Tendency of Austenitic Stainless Steel

C 795 Standard Specification for Wicking-Type Thermal Insulation for Use Over Austenitic Stainless Steel

C 871 Standard Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions

C 1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

D 312 Standard Specification for Asphalt Used in Roofing

2.2 Process Industry Standards

INIH1000 Hot Insulation Installation Details

2.3 Occupational Safety and Health Administration

29 CFR 1910.144 Safety Color Code For Marking Physical Hazards

29 CFR 1910.1200 Hazard Communication

3.0 General Requirements

3.1 Insulation Systems

The following insulation codes are used to identify the functions of thermal insulation on mechanical pipe and equipment:

- Hot services
  - HC: heat conservation
  - PS: process stability
  - PP: personnel protection
  - HF: hot and fire protection
  - PG personnel protection guards
- No insulation
  - NI: no insulation

Insulation for cold services shall be cellular glass. Contraction joints and a vapor barrier covering are not required for cellular glass. Joint sealant shall be used in all insulation joints and to provide vapor stops at insulation terminations.

Insulation for hot services shall be as follows:

- Vertical Equipment
  - Shell mineral fiber semi-rigid board
  - Top head expanded perlite block, or calcium silicate
  - Bottom head mineral fiber blanket
- Horizontal Equipment
  - Shell expanded perlite block, or calcium silicate
  - Heads mineral fiber blanket
- Piping
  - All surfaces expanded perlite block, or calcium silicate

Cellular glass, mineral fiber, or calcium silicate materials may be used for hot services, if approved by the BUYER, but only in the allowable temperature ranges specified in Section 4.2.

The Component Information System (CIS) and associated lists identify the appropriate insulation function code(s) for piping. Piping isometric drawings show the extent of insulation for piping and associated components. Equipment general arrangement drawings and equipment data sheets specify the extent of insulation for equipment. Piping and instrument diagrams (P&IDs) indicate where insulation is required.

If several insulation function codes are applicable, the most stringent requirements shall govern. For example, surfaces above 140°F that can be readily touched by operating or maintenance personnel require personnel protection (code PP). Where other insulation functions may be specified, the most stringent thickness requirement shall apply. In situations where insulation is not practical or appropriate, expanded metal guards (designated as code PG) shall be used for personnel protection rather than insulation.

All thermal insulation shall be protected by aluminum or stainless steel sheet metal jacketing unless specified otherwise. Jacketing shall support the insulation, protect it from damage, and provide weather protection (prevent ingress of water).

3.2 Extent

Removable and reusable insulation should be used in areas requiring periodic access for maintenance.

PP insulation shall be used on surfaces that are accessible to personnel if the maximum temperature exceeds 140°F, with guards (code PG) installed where insulation is not practical or appropriate. Accessible areas include those where personnel perform anticipated operations or maintenance, and include surfaces up to 7 ft above grade, floors, or platforms, and 3 ft horizontally from the periphery of platforms, walkways, or ladders.

Table 3.2 defines the extent of thermal insulation for other function codes.

Table 3.2, Extent of Insulation for Functions Other Than AS and PP

Surfaces to be Insulated	Insulation Function Codes		
	HC	PS	HF, ET, ST, PF
Straight or bent pipe; socketweld, threaded or buttweld pipe fittings, and valves.	YES	YES	YES
Pipe unions	NO[2]	NO[2]	NO[1]
Steam traps, related strainers	NO[2]	NO[2]	NO[1]
Flanged valves (except relief and control valves), flanged orifice sets, piping flanges connected to equipment nozzles	YES[3]	NO[1,3]	YES[3]
Primary piping for instrument connections, sample piping, vent and drain piping.	NO[1]	NO[1]	YES
Expansion or rotation joints, slide valves, etc.	NO[2]	NO[2]	YES[3]
Instruments and associated tube	NO	NO	YES
Relief valves	NO	NO	NO
Control valves, flanged pipe fittings	NO[1,3]	NO[1,3]	YES[3]
Tee and inline strainers	NO[1,3]	NO[1,3]	YES[3]
Heat exchangers, shell side, tube side, excluding body flanges	YES	YES	NA
Heat exchanger body flanges	NO[1,3]	NO[1,3]	NA
Pump casings	NO[1.3]	NO[1.3]	YES[3]
Compressors	[3]	NO[1]	NA
Blowers, fans	[3]	YES[2]	NA

[1] Insulate or guard only where required for personnel protection.
[2] Provide removable metal guards or barriers where required for personnel protection.
[3] Removable and reusable covers should be considered.
[4] Insulation should not be used in inaccessible areas where maintenance is infeasible (e.g., high radiation areas).

Removable, reusable insulation shall be used in areas where insulation may be removed more frequently than once every 20 months (e.g., for flanges or other components requiring periodic maintenance).

3.3 Thickness

Insulation shall be applied in one layer with the thickness per Appendix A unless specified otherwise. Insulation thickness depends on the insulation function (insulation code), normal or maximum operating temperature, and item diameter.

4.0 Materials

4.1 General

4.1.1 The BUYER only shall judge equivalency of materials. The SELLER shall submit complete details with any request for substitution or deviation from this specification.

4.1.2 All insulation and non-metallic accessory materials shall contain no asbestos.

4.1.3 All expanded perlite, calcium silicate, mineral fiber insulation, and mineral fiber cement or other proposed substitution products shall be qualified for use on austenitic stainless steel in accordance with ASTM C 795 by conforming to the pre-production test requirements of ASTM C 692 and the confirming quality control requirements for chemical analysis of ASTM C 871.

4.1.4 Deleted

4.1.5 Mineral fiber insulation materials shall have less than 30% cumulative shot content as determined by ASTM C 612 Annex A1. Density of mineral fiber products shall be determined by ASTM C 612, C 302, or C 303, as appropriate. "Delivered density" based on 40% shot content calculated per ASTM C 612 shall not be used.

4.1.6 All mastics, cements, caulks, compounds, kraft paper, and other materials used in insulation systems for stainless steel piping and equipment shall be free of leachable lead, bismuth, zinc, mercury, antimony, cadmium, and tin. The inorganic halogen content shall be less than 200 ppm; sulfur content shall not exceed 400 ppm. The low melting elements mentioned above shall be less than 1 percent by weight with mercury less than 50 ppm.

4.2 Insulation

4.2.1 Table 4.2 lists insulation materials and the allowable temperatures and functions for each material.

Table 4.2, Insulation Materials

Material	Description	ASTM Standard	Allowable Process Fluid Temperatures	Allowable Functions
Calcium Silicate	Block and Pipe Covering	C533	320°F to 1130°F	HC, PS, PP, HF
Cellular Glass	Block and Pipe Covering	C552	-355°F to 320°F	All
Mineral Fiber	Preformed Pipe Insulation	C547	230°F to 1130°F [1]	HC, PS, PP (see Note 1)
Mineral Fiber	Blanket	C592	230°F to 1130°F	HC, PS, PP
Mineral Fiber	Semi-Rigid Board	C612	230°F to 1130°F	HC, PS, PP
Expanded Perlite	Block and Pipe Covering	C610	77°F to 1130°F	HC, PS, PP, HF, ET, ST, PF

[1] Although not preferred, mineral fiber insulation material may be used in cold services (codes AS, ET, ST, and PF) at fluid temperatures down to 32°F with BUYER's approval if suitable ASTM C1136 vapor barriers are provided on all insulation surfaces and vapor stops are provided at insulation terminations to prevent water intrusion.

4.2.2 Mineral fiber board, rigid and semi-rigid, used for vertical equipment surfaces shall meet the requirements of ASTM C 612, Class 4 and be suitable for continuous service at system operating temperatures, and shall have a nominal density of 8 lbs/ft^3.

4.2.3 Mineral fiber blanket insulation used for bottom heads of vertical equipment and heads of horizontal equipment shall meet the requirements of ASTM C 592 Class II with the following exceptions:

- Nominal density shall be 8 lbs/ft^3
- One side shall be faced with stainless steel hexagonal mesh

4.2.4 Molded mineral fiber insulation piping ell covers suitable for operating temperatures may be used for all hot applications.

4.2.5 Expanded perlite block and pipe covering used for all piping, horizontal equipment, and vertical equipment top heads shall meet the requirements of ASTM C 610, Type II only, and shall exhibit water repellency up to a service temperature of 410°F.

4.2.6 Cellular glass insulation shall meet the requirements of ASTM C 552. For operating temperatures above 185°F, fabrication of piping insulation and curved radius segments shall be laminated using gypsum cement, not hot asphalt.

4.2.7 Calcium silicate block and pipe insulation shall meet the requirements of ASTM C 533 Type I and shall be marked continuously to designate that no asbestos is present.

4.3 Insulation Form

4.3.1 Shop-fabricated rigid insulation segments used for all elliptical, conical, torispherical, flanged and dished, or hemispherical top heads of vertical equipment shall be fabricated from cellular glass, rigid expanded perlite block, or calcium silicate. Both inside and outside surfaces shall be cut to match the compound curvature of the head. Each of the four sides shall be machined at the necessary bevel angle and radius to match the adjoining courses. Blocks shall be individually numbered and supplied with an assembly map to indicate the relative location of the numbered pieces.

4.3.2 Curved cellular glass sections used for equipment shells and pipe insulation shall be of a density between 7 and 8 lb/ft^3 in accordance with ASTM C 552, "Cellular Glass Block and Pipe Thermal Insulation". Acceptable materials are Pittsburgh-Corning Corporation "Foamglas" or approved equal. Thermal conductivity at 50°F shall be less than 4.6×10^{-4} Watts cm/cm^2 °C (0.32 BTU in/hr ft^2 °F). Curved sections for equipment shells and piping insulation shall be manufactured from billets assembled with ASTM D 312 Type III hot asphalt. A factory coating of ASTM D 312 Type II or III hot asphalt shall be applied on the exterior curved surfaces and interior bore. For operating temperatures above 185°F, gypsum cement should be used instead of hot asphalt per section 4.2.6.

4.3.3 Flat stock insulation materials that are grooved to fit cylindrical surfaces for equipment shells and pipe sizes above 12 inches shall be vee-cut so that the cuts close completely along their entire length when the insulation is installed. Materials used for fabrication shall conform to the requirements of this specification. Dimensions of the installed product shall conform to ASTM C 585 for pipe insulation. Backing and adhesives are subject to review and approval by the BUYER.

4.3.4 Loose fill material and cushioning blanket for service temperatures to 680°F shall contain no asbestos, have a density greater than 8 lbs/ft^3, and be glass fiber needled together to form a mat without the use of binders. The following materials are acceptable:

- Alpha Associates "Filomat D"
- Burlington Glass Fabrics "Burlglass 1200"

4.4 Mastics and Cements

4.4.1 Mineral fiber thermal insulating cement shall meet the requirements of ASTM C 195. Insulating and finishing cement shall meet the requirements of ASTM C 449. Reinforcing wire mesh shall be 1 inch hex x 0.023 inch three twist Monel or 18-8 SS wire.

4.4.2 Caulking compound for temperatures up to 365°F sealant shall be silicone rubber, Dow Corning 999 Silicone Rubber, or equal. Compound exposed to temperatures between 365°F and 680°F shall be Childers CP-79 or equal.

4.4.3 Reinforced weatherproofing compound shall be acrylic or vinyl acrylic water base emulsion and reinforced with a Dynel, nylon, or polyester leno weave or knitted fabric with 10 x 10 mesh per inch and a weight of 2 oz/yd^2.

4.4.4 Heat transfer cement shall be appropriate for the tracer temperature and process temperature. The cement shall be compatible with the surface coating system or steel substrate. Preformed flexible heat transfer cement may be used. On carbon steel pipe, steel channel to cover tracer shall be galvanized. For coupling vessel walls with plate heat coils, a non-hardening heat transfer cement shall be used. If required, insulation tape shall be 2 inches wide x 1/8 inch thick plain weave, suitable for operating temperatures to 1000°F.

4.4.5 Joint sealant for cellular glass at all temperatures, and vapor stop sealant for temperatures above 5°F for cellular glass shall be Foster Sealant 95-50. Below 5°F, sealant for vapor stops shall be Foster 90-66. Reinforcement for vapor stops (and weather barrier) shall be synthetic cloth equal to Pittsburgh-Corning PC Fabric 79, or BUYER-approved equal.

4.5 Jacketing

4.5.1 Aluminum jacketing shall be ASTM B 209 Alloy, 1100, 3103, 3105 or 5005 with an H14 temper. Jacketing for piping size 28 inches and below shall be flat, smooth. Jacketing for horizontal equipment shells and piping sizes above 28 inches shall be stucco embossed sheet. Jacketing for vertical equipment shells shall be furnished 1 1/4 inch corrugated. The corrugations shall be 1/4 inch deep. Jacketing for exposed equipment heads shall be gores fabricated from stucco embossed sheet.

Nominal thickness shall be 0.016 inch for piping and 0.024 inch for equipment.

Jacketing shall have a factory applied moisture barrier that is continuously heat-sealed to the aluminum. The moisture barrier shall consist of a 3 mil high density polyethylene, Poly-Surlyn film, or one layer of 40 lb virgin kraft paper laminated with a one mil polyethylene adhesive.

If specified by the BUYER, jacketing shall be supplied with a polyvinylidene fluoride (PVDF) or acrylic exterior coating and the specific color shall be approved by the BUYER. Otherwise all metal jacketing shall be the natural color of the jacketing material.

4.5.2 Stainless jacketing shall be ASTM A 240 Type 304 flat, smooth sheet 0.016 inch thick furnished in the annealed or soft condition with a regular 2B mill finish and have a factory applied moisture barrier as specified for aluminum jacketing.

4.5.3 Die formed two-piece aluminum ell covers shall be used for NPS 12 and smaller pipe sizes. Die formed four piece aluminum ell covers or molded fiberglass covers shall be used for sizes above NPS 14. Aluminum covers shall be deep drawn from 0.024 inch thick aluminum alloy 1100-0. Fiberglass covers shall be 0.040 inch thick flame retardant polyester.

Aluminum covers shall have a factory applied moisture barrier coating such as PVDF or Poly-Surlyn on the inner surface. The external surface of aluminum covers shall be coated or not coated to match the adjacent pipe jacket. Vapor barriers used with fiberglass insulation or other mineral fiber insulation for cold services shall comply with ASTM C1136.

4.5.4 If available, stainless steel die formed covers with a factory applied moisture barrier shall be furnished for ells and tees. Gored segments or stove-pipe construction of 304 stainless steel may be substituted.

4.5.5 Gored segmented aluminum or stainless steel covers shall be used over welded tees. The metal thickness and coating shall be the same as adjacent pipe jacketing. The seams shall shed water and keep the insulation dry. Flanged tees shall be insulated with flexible removable covers and shall not have metal covers.

4.6 PP Guards (Code PG)

4.6.1 Personnel protection guards shall be fabricated from perforated or expanded metal. For hot stainless steel pipe or equipment to be protected, the expanded metal guard shall be Type 304 stainless steel. For carbon steel surfaces, galvanized steel shall be used. Support may be provided by structural steel anchored at the equipment foundation or by clips banded to the piping or equipment. Support clips shall be designed to locate the expanded metal a minimum of 3 inches from the hot surface, and shall be the same or compatible material as the pipe or equipment.

4.6.2 Guards on flanged connections and equipment shall be designed for convenient removal for maintenance access. Individual section shall not weigh more than 40 lbs.

4.6.3 Typical design sketches for metal shields shall be submitted by the SELLER and shall be approved by the BUYER prior to fabrication or installation.

4.7 Insulation and Jacketing Securement

4.7.1 Tie wire, lacing wire, and lacing hair pins shall be 16 gauge Type 304 soft annealed SS wire.

4.7.2 Tape for fastening cellular glass pipe insulation shall be 3/4 inch wide fiberglass reinforced filament tape. The tape shall not be applied to stainless steel unless it conforms to the halogen content requirements of Section 4.1.6.

4.7.3 Bands shall be 0.020 inch thick by 0.50 inch or 0.75 inch wide as required by Sections 4.0, 5.0, and 6.0 and conform to ASTM A 240 Type 302 or 304 stainless steel. Seals shall be heavy-duty wing type or crimp (closed) type fabricated from 0.032 inch thick ASTM A 240 Type 302 or 304 stainless steel. Crimp (closed) type seals are required with spring tensioned banding.

4.7.4 Springs for securement of jacketing on piping and rigid insulation on equipment shall be Type 302 stainless steel limited expansion type. Springs for securement of jacketing on vessels and tanks with diameters exceeding 10 feet shall be compression type.

4.7.5 Sheet metal screws shall be #8 x 1/2 inch 18-8 SS self-tapping screws with elastomeric gaskets.

4.7.6 Stainless Steel "S", "J", or "U" Clips for supporting metal jacket courses or banding shall be 0.020 inch thick by 0.75 inch wide ASTM A 240 Type 302 or 304 stainless steel.

5.0 General Installation Requirements

5.1 Safety

5.1.1 All surface preparation, materials, and work shall comply with all applicable environmental and safety provisions, laws, regulations, ordinances, etc., of the city, county, state, province, or nation pertaining to the work being performed and the materials being used. Work being performed in the United States shall also be in strict accordance with federal (OSHA Standard 29 CFR 1910.144), state, and local safety and environmental requirements.

5.1.2 SELLER shall comply fully with OSHA Hazard Communication Standard 29 CFR 1910.1200 or the applicable country code. Material Safety Data Sheets (MSDS) shall be provided by the materials Supplier and available at the place of application for review.

5.1.3 The volatile organic compound (VOC) content of all materials shall meet federal, state, and local or other regulatory requirements.

5.2 Weather Protection

All insulation and necessary materials shall be protected from moisture during storage and installation. Temporary polyethylene sheeting shall protect insulation in wet weather conditions until the final application of the permanent jacketing. Wet insulation is unacceptable and must be replaced with dry materials. Expanded perlite and cellular glass that has been exposed to the rain or other moisture shall be dried to the BUYER's satisfaction. Mineral fiber and calcium silicate that becomes wet shall be removed from the site and not used.

5.3 Conditions of Surfaces to be Insulated

5.3.1 All surfaces to be insulated shall be clean and dry.

5.3.2 Because corrosion is more aggressive to insulated surfaces than uninsulated surfaces operating in the temperature ranges just above ambient, all carbon steel normally operating at temperatures up to 300°F will be coated with epoxy.

5.3.3 No insulation shall be installed until completion of any stress relieving, chemical cleaning, coating application, pressure testing, tracer installation, and release of the surfaces in writing by the BUYER's site representative.

5.4 Insulation Fit-Up

5.4.1 All voids and cracks (larger than 3/32 inch) in hot insulation shall be pointed and filled with the insulating cement. Thickness of cement on irregular surfaces shall equal the thickness of the adjacent preformed insulation. Cracks larger than 5/16 inch shall be corrected by re-fitting the insulation unless filling is accepted by the BUYER.

For anti-sweat insulation, all joints shall be fitted up to be 1/16 inch or less or the insulation removed and remachined. All joints shall be completely filled with joint sealant from interior to exterior surface.

5.4.2 For rigid insulation materials, a 1 inch gap adjacent to support rings, tie bars, or piping ells shall be provided as an expansion joint. The joint shall be filled with loose fill material. Piping ells insulated with preformed mineral fiber do not require expansion joints.

5.4.3 Flanged fittings, flanged valves, flanged pumps, flanged blinds and single flange pairs on piping and equipment including manways and nozzles, if insulated, shall be insulated last, after the completion of all testing, and insulation of adjacent pipe or equipment surfaces.

5.5 Multi-Layer Insulation

Where possible, insulation shall be applied in a single layer as indicated in the insulation thickness tables of Appendix A. When multi-layer construction is used, joints of the top two layers shall be offset at least 1.5 inches from each other using staggered layer techniques to ensure all joints in each layer are offset.

5.6 Jacketing and Compound

5.6.1 Unless specified otherwise, aluminum jacketing shall be used for all insulation except for function HF, which shall have stainless steel jacketing.

5.6.2 Reinforced mastic weather coating compound may be used on surfaces of complex shapes that cannot be fitted with aluminum and do not require fire resistance as for function HF. It shall be used only on calcium silicate and perlite insulation. The emulsion-type weather coating shall not be applied when atmospheric precipitation or condensation may wet the finished surface within 24 hours after application.

The mastic weather coating shall be applied as follows for most applications:

- Apply a layer of finishing cement over the insulation to provide a smooth, even surface
- Apply mastic to 1/8 inch wet thickness
- While still wet, wrap with reinforcing fabric. Lap joints 2 inches
- Apply finish coat of mastic to completely cover fabric. The total dry film thickness shall be a minimum of 1/8 inch

5.6.3 Jacketing shall prevent entry of liquid water into the insulation under all normal weather conditions and wash down operations. The design of the jacketing shall be such that joints shed water and do not depend on organic caulks to prevent the ingress of water. All penetrations through the metal jacketing shall be flashed to lap the penetration and jacketing a minimum of 3 inches, banded, and sealed with caulk.

5.7 Fireproofing Insulation

For fireproofing insulation, function HF, the metal jacket on piping and equipment shall be stainless steel rather than aluminum or mastic coating. Insulation for function HF shall be cellular glass or calcium silicate. HF insulation thickness shall be as specified on applicable drawings, data sheets, and/or other specifications, but shall be 2.5 inches minimum thickness. For both piping and cylindrical equipment, the insulation as well as the jacketing shall be circumferentially banded with 1/2-inch stainless steel bands on 6 inch centers.

5.8 Installation Details

Typical insulation details are provided in Process Industry Practices INIH1000 and INIC1000. The SELLER may submit alternate sketches for BUYER approval.

5.9 Piping Versus Equipment Installation Methods

Heat exchanger and cylindrical equipment shells less than 24 inches in diameter shall be insulated in the same manner as piping. Piping larger than 48 inches shall be insulated by the methods specified for equipment. Heads on equipment less than 24 inches diameter shall be insulated with a flat disk of block butted against extended cylindrical shell insulation.

6.0 Specific Installation Requirements for Piping

6.1 Insulation Placement

6.1.1 On traced lines, the preformed pipe covering shall be of a larger insulation size or used in combination with straight block insulation as required to enclose the trace line without grooving the insulation.

6.1.2 Circumferential joints of pipe insulation sections shall be offset or staggered between top and bottom sections by a section half length. Longitudinal joints shall be nearly horizontal, and in multi-layer construction, shall not coincide with the longitudinal joints of previous (or subsequent) layers. The offset distance between staggered joints shall be at least 1.5 inches. Hinged vee-grooved pipe covering is permitted on hot piping insulation sizes larger than 12 inches. If hinged vee-grooved insulation sections are used, the hinge shall be located on top to shed any encroaching water. Only the second and third layers may be combined into a composite block for application as a unit.

6.1.3 Where insulation terminates on pipe runs, insulation will be stopped short a minimum 1.25 times the bolt length from the face of the flange or sufficient distance to remove flange bolts without disturbing the insulation and jacketing.

6.1.4 Hot welded and screwed fittings and valves 3 inches and smaller can be insulated with wire mesh reinforced combination insulating and finishing cement applied in 0.5 inch layers to achieve the thickness of the adjacent pipe insulation.

6.2 Insulation Support

6.2.1 Insulation and jacketing on vertical piping shall be supported on an approved bolt-on support ring supplied and installed by the SELLER. Carbon steel rings shall be installed on carbon steel pipe and stainless steel rings shall be installed on chrome steel (Cr-Mo), austenitic stainless steel, Inconel, and Hastelloy piping.

6.2.2 Ring supports shall be installed at the bottom of the pipe run and above interruptions in the pipe run such as at flanges and valves; however, maximum spacing shall be 13 feet. Support rings are not required for vertical rises less than 6 feet when measured from the bottom of a pipe run or from a support at an interruption.

6.2.3 Rings shall be sized to support all layers of insulation but smaller than the insulation diameter. A 0.5 inch gap shall be maintained between the insulation jacketing and the outside edge of the support ring.

6.3 Hot Insulation Expansion Joints

6.3.1 Periodically, circumferential joints shall be filled with loose glass fill or mineral fiber blanket to make an expansion joint in the rigid insulation covering. The fill shall be compressed 50% during installation to yield a joint 1 inch wide. The joint shall be filled completely to the full layer thickness of the insulation.

6.3.2 The expansion joints shall be spaced equally between pipe supports or pipe anchors but shall not exceed the distance between expansion joints listed in Table 6.3.

Table 6.3, Expansion Joint Spacing

OPERATING TEMPERATURE	MAXIMUM DISTANCE
Below 320°F	33 feet
320°F to 500°F	26 feet
Above 500°F	16 feet

6.4 Insulation Securement

6.4.1 Each individual pipe insulation section shall have a minimum of two securements.

6.4.2 Cellular glass shall be secured with adhesive tape on 9 inch centers before jacketing is banded in place.

6.4.3 Each layer of expanded perlite and calcium silicate insulation shall be secured to pipe using tie wire, 0.5 inch wide stainless steel bands, or adhesive tape on 9 inch or 12 inch spacing according to Table 6.4.

Table 6.4, Securement Spacing

PIPE SIZE (inches)	NUMBER OF LAYERS	OUTER LAYER SECUREMENT / SPACING (inches)	INNER LAYER SECUREMENT / SPACING (inches)
Below 12	1, 2 or 3	Wire/9	Wire/12
12 to 28	1	Wire/9	N.A.
12 to 28	2 or 3	Bands/12	Wire/9
Above 28	1	Bands/9	N.A.
Above 28	2 or 3	Wire/9	Wire/9

6.5 Jacketing Securement

6.5.1 On horizontal pipe insulation, metal jacketing shall overlap 3 inches both longitudinally and circumferentially. Seams shall be arranged to shed water, i.e., the upper shall overlap the lower sheet. Longitudinal seams shall be located at the 3:00 or 9:00 position on the pipe circumference. Securement of the metal jacket shall be by 0.5-inch wide bands placed on the circumferential overlaps and on 12-inch centers.

6.5.2 On vertical pipe insulation, metal jacketing shall overlap 2 inches for circumferential seams and 3 inches for longitudinal seams. Jacketing shall be supported from insulation support rings or from jacketing below using 3 or more stainless steel "S" clips. Circumferential joints shall be lapped to shed water. The longitudinal seam shall be located on the leeward side from the prevailing storm wind direction if possible. In any case, the joints shall be located so they are easily accessible for caulking. Securement of the metal jacket shall be by 0.5 inch bands placed on the circumferential overlaps and by screws on 3 inch centers along the longitudinal over-laps. Screws shall be placed in the longitudinal over-laps so that circumferential joints are free to accommodate expansion and contraction movements. Longitudinal seams of vertical pipe jacketing shall be caulked.

6.5.3 Expansion springs shall be fitted to bands that secure jacketing over multi-layer insulation on piping larger than 28 inches. Bands shall not be located adjacent to jacketing laps. Springs shall be extended 1.3 times their original length when tensioned.

6.5.4 Die formed covers shall have their heel and throat fastened with screws on 4-inch maximum centers. The cover sections shall overlap themselves and the pipe jacketing at least 2 inches. Bands 0.5-inch wide shall secure each end of the cover to the pipe jacketing.

6.6 Caulking

A heavy fillet of heat resistant caulk shall be applied around flashing at all protrusions through the jacketing. Protrusions must rely on flashing to keep water out. Other jacket-to-jacket seams not waterproof by virtue of their design shall be caulked with silicone rubber sealant.

7.0 Specific Installation Requirements for Vessels and Heat Exchangers

7.1 Insulation Placement

7.1.1 Unless otherwise approved by the BUYER, expanded perlite or calcium silicate rigid block insulation shall be used as the single layer on all shells of horizontal equipment. Semi-rigid mineral fiber board shall be used as the single layer on vertical equipment shells.

7.1.2 Joints shall not align between the top two layers of multi-layer insulation but shall be offset at least 1.5 inches.

7.1.3 Heads on equipment 24 inches diameter and less shall be insulated with a flat disk of block butted against extended cylindrical shell insulation.

7.1.4 Top heads and heads not protected by a skirt on vertical equipment larger than 24 inches diameter shall be insulated with shop fabricated rigid insulation segments. Machine cut rigid block for heads shall be installed in the locations indicated by the manufacturer's map.

7.1.5 Heads protected by a skirt and heads on horizontal equipment larger than 24 inches shall be insulated with mineral fiber blanket applied over steel surfaces operating below 680°F. For horizontal equipment shells, rigid blocks shall be installed with the long axis of the insulation block parallel to the equipment axis. The first course of block applied around the equipment shell circumference shall be applied with every other block cut to a half length so that circumferential joints are broken or staggered between adjacent blocks of the first and subsequent courses.

7.1.6 Cut and bevel blocks as necessary to obtain joints no wider than 7/32 inch at the outside surface of the insulation. Rigid block lengths shall be at least 18 inches. Acceptable maximum rigid block widths are as follows in Table 7.1.

Table 7.1, Rigid Block Widths

EQUIPMENT SIZE	MAXIMUM BLOCK WIDTH
Up to 39 inch diameter	3 inch vee-cut block or pipe covering
39 to 79 inch diameter	4 inch vee-cut block
79 to 118 inch diameter	6 inch vee-cut block
Above 118 inch diameter	9 inch vee-cut block

7.1.7 For Vertical Equipment shells, semi-rigid board shall be installed in vee-grooved sections for diameters less than 13 feet. For shell diameters larger than 13 feet, flat board is acceptable.

7.2 Insulation Securement

7.2.1 Adhesives shall not be used to hold insulation on equipment.

7.2.2 Cellular glass, if used, shall be secured with 0.75 inch wide fiberglass tape on 9 inch centers before jacketing is banded in place.

7.2.3 Each layer of rigid insulation shall be secured to equipment shells using 0.5 inch wide stainless steel bands. Where required, insulation shall be coped to accommodate expansion springs below the profile of the insulation. Expansion springs and securement shall be according to the Table 7.2.

Table 7.2, Expansion Springs and Securements

EQUIPMENT DIAMETER	NUMBER OF INSULATION LAYERS	OUTER LAYER SECUREMENT	INNER LAYERS SECUREMENT	EXPANSION SPRINGS PER BAND
39 to 118 inches	1, 2 or 3	Bands	Bands	None
Above 118 inches	1	Bands	N.A.	1
Above 118 inches	2 or 3	Bands	Bands	2, 180° Apart

7.2.4 Each layer of mineral fiber semi-rigid board insulation shall be secured with bands 0.75 inch wide. Expansion springs are not required.

7.2.5 Secure shell insulation by banding each layer on 12 inch maximum centers. For longer block or board lengths, 18 inch maximum centers may be used, but secure every block or board with a minimum of two bands.

7.2.6 Extend head bands radially from a central floating ring, and space them to provide at least one band per block at extreme circumference of the head. Bands shall be applied and sealed under tension by machine.

7.2.7 Where projections prevent a continuous band, secure the band at the projection by a bridle ring. Tie wire may be used to hold the blocks where projections prevent the use of continuous bands, e.g., between platform or ladder support brackets.

7.2.8 Insulating cement shall be used to fill up any voids or cracks flush with the block surface. See Section 4.4.

7.2.9 Expansion joints are required on horizontal vessels operating above 320°F or having a tangent length greater than 20 feet. An expansion joint shall be provided for each 10 feet of length and be equally spaced along the length. Fill expansion joints with loose mineral fiber or glass fiber.

7.2.10 Removable blanket insulation, where designated for manways, heads, and flanges shall be installed after all permanent insulation work is completed.

7.3 Jacketing Securement

7.3.1 Corrugated covering on vertical equipment shall be installed with corrugations running vertically with a minimum of 2.5 corrugations overlap. The edge of the sheet shall terminate in a valley. Circumferential overlap shall be 4 inches.

7.3.2 For stucco embossed jacketing on horizontal equipment, longitudinal and circumferential joints shall be lapped 3 inches and arranged to shed water.

7.3.3 Each section of metal jacketing shall be supported from the next lower section with "S" clips. The bottom section of covering shall be supported by "J" clips attached to the insulation support.

7.3.4 The covering shall be banded with 3/4 inch wide bands over circumferential laps with intermediate bands on 12 inch maximum centers. For resistance to high winds, band spacing shall be 9 inches with 2 bands located on circumferential overlaps.

7.3.5 Bands over rigid insulation and jacketing without corrugations shall have expansion devices as specified for the outer layer of insulation in Table 7.2.

7.3.6 Bands without springs shall be tensioned sufficiently to remove all slack.

7.3.7 Bands shall be supported by a minimum of two "S", "U", or "J" clips with a maximum spacing of 6 feet between supports. Springs, if present, shall be located away from jacketing laps.

7.3.8 On vertical vessels, metal screws shall be installed on 6 inch maximum centers in longitudinal seams. For resistance to high winds, screws shall be installed on 4 inch maximum centers.

7.3.9 Head gore segments shall be fastened to each other with screws on 6 inch centers and bands placed over each gore. For resistance to high winds, screws shall be installed on 4 inch maximum centers.

7.3.10 Flashing and a heavy fillet of silicone caulk shall be used to seal around all projections through the jacketing and all longitudinal seams. Jacketing shall be cut to fit tightly around all penetrations while allowing adequate room for expansion and contraction over the operating temperature range. All penetrations must be designed and flashed so that water will not enter.

10.0 Documentation and Submittals

10.1 SELLER shall submit detailed installation procedures complete with detailed sketches showing methods of applying insulation, particularly for valves, flanges, fittings, expansion joints, and metal jacketing.

10.2 All materials used must be completely described as to manufacturer and type. The SELLER shall furnish a certificate from the manufacturer confirming compliance with all requirements of Sections 2.0 and 3.0.

10.3 SELLER's procedures must describe how materials will be stored, handled, mixed, and used in accordance with the manufacturer's printed instructions.

10.4 SELLER shall maintain a copy of their procedures properly revised and used by site supervision to control the execution of the work. The procedures and revisions thereof must be submitted for the BUYER's review and authorization to proceed prior to use.

11.0 Inspection

The BUYER reserves the right to inspect the insulation prior to and after jacketing installation. The SELLER shall replace or correct any materials or installations that do not meet the requirements of this specification and reference drawings.

Appendix A
Insulation Thickness Tables

Table A-1

Insulation Thickness for Heat Conservation (HC), Process Stability (PS), Electric Traced (ET), and Steam Traced (ST) Function Codes

Pipe Size (inches)	Normal Operating Temperature of Process Fluid (°F)						
	≤ 140	140-230[1]	231-320	321-410	411-500	501-590	591-680
	Insulation Thickness (inches) [1]						
0.5	1.0	1.0	1.0	1.5	1.5	2.0	2.5
0.75	1.0	1.5	2.0	2.5	2.5	3.0	3.0
1	1.0	1.5	2.0	2.5	2.5	3.0	3.0
1.25	1.0	2.0	2.0	2.5	3.0	3.0	3.0
1.5	1.0	2.0	2.0	2.5	3.0	3.0	3.0
2	1.5	2.0	2.5	2.5	3.0	3.0	4.0
3	1.5	2.5	2.5	3.0	3.0	4.0	4.0
4	1.5	2.5	3.0	3.0	3.0	4.0	4.0
6	1.5	2.5	3.0	4.0	4.0	4.0	4.0
8	1.5	2.5	3.0	4.0	4.0	4.0	4.0
10	1.5	2.5	3.0	4.0	4.0	4.0	4.0
12	1.5	2.5	4.0	4.0	4.0	4.0	4.0
14	2.0	3.0	4.0	4.0	4.0	4.0	4.0
16	2.0	3.0	4.0	4.0	4.0	4.0	4.0
18	2.0	3.0	4.0	4.0	4.0	4.0	4.0
20	2.0	3.0	4.0	4.0	4.0	4.0	4.0
24	2.0	3.0	4.0	4.0	4.0	4.0	6.0
30	1.5	3.0	4.0	4.0	4.0	4.0	6.0
36	1.5	3.0	4.0	4.0	4.0	6.0	6.0
48	1.5	3.0	4.0	4.0	4.0	6.0	6.0
Flat	2.0	4.0	4.0	4.0	6.0	6.0	6.0

[1] HC insulation is not required for normal process fluid temperatures below 70°F (for outdoor or unheated locations) and 100°F (for indoor, heated locations).

Table A-2

Insulation Thickness for Personnel Protection (PP) Function Code

Pipe Size (inches)	Maximum Operating Temperature of Process Fluid (°F)					
	140-230[1]	231-320	321-410	411-500	501-590	591-680
	Insulation Thickness (inches) [1]					
0.5	0.5	0.5	0.5	1.0	1.0	1.5
0.75	1.0	1.0	1.0	1.5	1.5	2.0
1	1.0	1.0	1.0	1.5	1.5	2.0
1.25	1.0	1.0	1.0	1.5	2.0	2.0
1.5	1.0	1.0	1.0	1.5	2.0	2.0
2	1.0	1.0	1.0	1.5	2.0	2.5
3	1.0	1.0	1.5	2.0	2.0	2.5
4	1.0	1.5	1.5	2.0	2.5	3.0
6	1.0	1.5	1.5	2.0	3.0	3.5
8	1.5	1.5	2.0	2.5	3.0	3.5
10	1.5	1.5	2.0	2.5	3.5	4.0
12	1.5	1.5	2.0	2.5	3.5	4.5
14	1.5	1.5	2.0	3.0	3.5	4.5
16	1.5	1.5	2.5	3.0	4.0	5.0
18	1.5	1.5	2.5	3.0	4.0	5.0
20	1.5	1.5	2.5	3.5	4.0	5.0
24	1.5	2.0	2.5	3.5	4.0	5.0
30	1.5	2.0	2.5	3.5	4.5	5.5
36	1.5	2.0	3.0	3.5	4.5	6.0
48	1.5	2.0	3.0	4.0	5.0	6.0
Flat	1.5	2.5	3.5	4.5	6.0	7.5

[1] Insulation thickness is based on maintaining 140°F jacket temperature; for process fluid temperatures below 140°F, insulation is not required for personnel protection (PP).

ATTACHMENT PS02

LAW TCO CUSTOMIZED PS02

Per 24590-WTP-3PS-PS02-T0001, Rev. 10
ENGINEERING SPECIFICATION FOR SHOP FABRICATION OF PIPING

This attachment defines the requirements and the work necessary for fabrication of piping subassemblies (pipe spools) in accordance with the requirements of ASME B31.3, Process Piping, other codes and standards, and documents as referenced in this specification. This specification applies to all quality levels as specified by the purchase order. For continuity and maintaining configuration control, the section numbers from the specification noted above have been retained.

1.2 Work Included

1.2.1.14 Perform Positive Material Identification (PMI) on completed fabrication in accordance with specification 24590-WTP-3PS-G000-T0002, *Engineering Specification for Positive Material Identification (PMI) for Shop Fabrication.*

1.4 Codes and Standards

1.4.1 ASME B321.3-1996; *Process Piping,* is the piping code for the WTP Project.

For Q applications, the editions of reference codes, standards and specifications shown in Appendix E of ASME B31.3-1996 listed below, and those listed in 24590-WTP-3PS-PB01-T0001, *Engineering Specification for Technical Supply Conditions for Pipe, Fittings, and Flanges,* are acceptable for use. If the Supplier wants to use a later edition or addenda of a reference code, standard, or specification then the Supplier shall submit an SDDR.

When using ASTM material specifications for commercial material (CM) items, any version more recent than the ASTM version listed in Appendix E of ASME B31.3 1996 is acceptable. An SDDR is not required for these commercial material (CM) item ASTM material specification edition changes.

ASME materials identified in ASME Boiler & Pressure Vessel Code, Section II Material Specifications as being identical to the ASME B31.3, Appendix E listed ASTM Material Specifications, for the year, alloy, type and / or grade, (if applicable), are acceptable for use.

See Specification 24590-WTP-3PS-PB01-T0001, Section 2.1 for ASTM Material Specifications table for acceptable years.

1.4.1.1 The American Society of Mechanical Engineers (ASME)

ASME B16.11-1991; *Forged Fittings, Socket-Welding and Threaded*

ASME B16.25-1986; *Buttwelding Ends*

ASME B16.28-1986; *Wrought Steel Buttwelding Short Radius Elbows and Returns*

ASME B16.36-1988; *Orifice Flanges*

ASME B16.47-1990; *Large Diameter Steel Flanges NPS 26 through NPS 60*

ASME B16.5-1988; *Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inches*

ASME B16.9-1986; *Factory-Made Wrought Buttwelding Fittings*

ASME B36.10M-1985; *Welded and Seamless Wrought Steel Pipe*

ASME B36.19M-1985; *Stainless Steel Pipe*

1.4.1.2 ASME Boiler and Pressure Vessel Code (B & PV)

ASME B & PV Code Section V- latest edition, *Nondestructive Examination*

ASME B & PV Code Section VIII, Division 1, latest edition, *Rules for Construction of Pressure Vessels*

ASME B & PV Code Section IX- latest edition, *Welding and Brazing Qualifications*

1.4.1.3 American Society for Testing and Materials (ASTM) Material Specifications

For ASTM material designations, refer to 24590-WTP-3PS-PB01-T0001, *Engineering Specification for Technical Supply Conditions for Pipe, Fittings, and Flanges*

1.4.1.4 Pipe Fabrication Institute (PFI) Standards

ES-7 - 1962 (R1984), *Minimum Length and Spacing for Welded Nozzles*

1.4.1.5 Manufacturers Standardization Society

MSS SP-25-1978 (R1988), *Standard Marking System for Valves, Fittings, Flanges, and Unions*

MSS SP-83-1987, *Class 3000 Steel Pipe Unions Socket Welding and Threaded*

MSS SP-95-1986 (R1991), *Swaged Nipples and Bull Plugs*

MSS SP-97-1987, *Integrally Reinforced Forged Branch Outlet Fittings*

1.4.2 Other Standards

The following standards are not reference standards of ASME B31.3, 1996, but are acceptable for use to facilitate ASME B31.3 piping fabrication, or are used for pipe fabrication that is not within the scope of ASME B31.3.

1.4.2.1 Pipe Fabrication Institute (PFI) Standards

ES - 3, Fabricating Tolerance

ES - 5, Cleaning of Fabricated Piping

ES - 16, (Deleted)

ES - 24, Pipe Bending Methods, Tolerances, Process, and Material Requirements

ES - 31, Standard for Protection of Ends of Fabricated Piping Assemblies

1.4.2.2 International Association of Plumbing & Mechanical Officials

Uniform Plumbing Code (UPC), 1997 Edition

1.4.3 In case of a conflict between the requirements of the referenced codes, standards, specifications, regulations, and procedures, the Supplier shall submit a recommended resolution to the BUYER via a Supplier Deviation Disposition Request (SDDR) for review and permission to proceed prior to implementation.

1.5 Reference Documents and Drawings

The entire list of documents below may or may not apply in all cases. Refer to the purchase order for a listing of those documents that are applicable.

1.5.1 24590-WTP-3PS-PB01-T0001, *Engineering Specification for Technical Supply Conditions for Pipe, Fittings, and Flanges*

1.5.3 24590-WTP-3PS-NWP0-T0001, *Engineering Specification for General Welding and NDE Requirements for Supplier Fabricated Piping*

1.5.9 24590-WTP-3PS-G000-T0002, *Engineering Specification for Positive Material Identification (PMI) for Shop Fabrication*

1.7 Cleaning and Coating

See Attachment AFPS for additional clarification.

1.7.1 Cleaning

1.7.1.1 Perform cleaning after fabrication has been completed. Cleaned piping shall be free of loose rust or mill scale, blisters, grease, sand, oil, dirt, and other foreign materials.

1.7.1.2 Fabricated spools shall be cleaned in accordance with the standard cleaning method described in PFI-ES-5.

1.7.1.3 Clean austenitic stainless steel, nickel alloy, and titanium piping in a protected area that is free from airborne chloride contamination. Prevent contamination from non-stainless steel, non-nickel alloy or non-titanium particles such as machine chips, grinding dust, weld spatter, and other debris during fabrication by shielding or other suitable means.

1.7.1.4 Only austenitic stainless steel brushes not previously used on other material may be used on austenitic stainless steel piping.

Stainless steel wire brushes that have not been used on other materials shall be used to clean nickel alloy or titanium.

1.7.1.5 Where solvent is required to remove grease or oil from austenitic stainless steel piping, acetone, or alcohol (ethyl, methyl, or isopropyl) shall be used. Alternatively, a detergent flush may be used in lieu of solvent cleaning with prior permission to proceed from BUYER.

- Cleaning solvents used for cleaning titanium materials are methyl alcohol, acetone, or other chlorine-free solvents.
- Titanium weld preparation includes removing any oil, grease, dirt, or grinding dust from surfaces to be joined. Steam cleaning or an alkali dip in a dilute solution of sodium hydroxide can remove most of these contaminants. To remove the last remaining organic compounds just before welding, use a lint-free glove and methyl alcohol, acetone, or other chlorine-free solvent.

1.7.1.6 Final cleaning materials in contact with austenitic stainless steel shall contain less than 200 ppm chlorides. If detergent cleaning is used, rinse austenitic stainless steel with potable water having no more than 100 ppm chloride content. After rinsing, the piping shall be drained out completely such that no standing pockets/puddles of water remain that may later concentrate by evaporation. Removal of excess rinse water may be augmented by swabbing, use of a "squeegee," or air blowing.

1.7.1.7 After cleaning, blow dry the interior surfaces of all piping with clean, filtered, oil-free air.

1.7.3 External Surface Coating

1.7.3.1 Apply external surface coating in accordance with Attachment AFPS, Appendix D, Number 8.20, System Code D.

1.7.3.4 Do not paint the gasket seating surface of flange faces. The gasket seating surface of flange faces shall be cleaned and coated with a one of the following rust preventives:

1.7.3.4.1 Grease (manufacturer's standard)

1.7.3.4.2 Lectra Shield and SP-400, CRC Industries

1.7.3.4.3 Mobilarma 247, Mobil

1.7.3.4.4 Any preservative listed in Attachment AFPS

1.8 Packaging, Storage, Handling, and Protection

Packaging, handling, and storage of pipe spools are as list below. These requirements are based on the applicable requirements listed in Specification 24590-WTP-3PS-G000-T0003.

1.8.1 Sealing Openings

1.8.1.1 Comply with the minimum end protection requirements criteria outlined in PFI-ES-31 to protect all openings and/or as required in the purchase order. The BUYER must provide review and give permission to proceed prior to use of each specific type of desiccant material. Fabrications must be clearly marked indicating desiccant inside.

1.8.1.2 Cover all pipe openings with metal, polyethylene, or nonmetallic end caps, flange protectors, or plugs. Polyethylene or nonmetallic end caps and plugs shall be friction fit, (e.g., Niagara series) or secured by other means. At a minimum, one of the caps or plugs on each spool shall be provided with a 1/8-inch max diameter vent hole to preclude the buildup of internal pressure. Avoid placing the cap or plug with the vent hole on a spool that is oriented in an upward, vertical position. Tape shall not be used to secure end caps or plugs. Clamps used for securing end caps, on stainless steel or alloy spools, shall be made of stainless material.

1.8.2 Marking

1.8.2.3 Any marking material and packing tape used on stainless steel or alloy material is required to be made from low chloride (less than 200 ppm) and low sulfur (less than 400 ppm) type material. The Supplier shall provide a chemical analysis report of the marker/tape for each lot or typical representative sample. The chemical analysis report shall be submitted for BUYER's review and permission to proceed. A copy of the report is not required with each shipment of pipe spools.

2.1.2 Material Traceability

2.1.2.1 Material traceability (such as identification of the item to applicable material specification, heat, batch, lot, part, or serial number or specified inspection, test, or other records) also includes transferring material identification mark(s) prior to subdividing material for all piping material. Traceability is being able to trace the piping material to the applicable MTR. All piping material, regardless of quality level, requires traceability.

2.1.5 Positive Material Identification (PMI)

To ensure material is correctly supplied as specified, the Supplier shall perform Positive Material Identification (PMI) tests in accordance with Specification 24590-WTP-3PS-G000-T0002. The Supplier shall submit their PMI test procedure for BUYER's review and permission to proceed. Note that PMI is not applicable for carbon steel materials and titanium materials. PMI is not to be performed on BUYER furnished valves unless otherwise stated in the purchase order.

2.1.6 Material Commitment

The Supplier shall submit to the BUYER a complete itemized listing of all materials purchased or reserved from the Supplier's inventory for each project. The Supplier shall also provide, upon request, the current status of pre-bought or BUYER-furnished material.

2.1.7 Material Substitutions

All materials shall be in accordance with the BUYER-furnished drawings, the purchase order, and specifications, unless written permission to proceed is granted by the BUYER via the SDDR in accordance with the purchase order requirement.

2.1.8 Material Identification and Marking

2.1.8.1 All materials shall be marked with the information and using marking materials required by the specific ASTM or ASME material specification.

2.1.8.2 Labeling with a marking pen on stainless steel and nickel based alloy material shall be done by any permanent method that will neither result in harmful contamination or sharp discontinuities, nor infringe upon the minimum wall thickness. All marking materials other than material manufacturer's marks shall be of the low chloride (less than 200 ppm) and low sulfur (less than 400 ppm) type. It is acceptable to use a rounded, low stress, vibro-etch tool for this marking.

2.1.8.3 Weld identification symbols must be recorded on detailed spool sheets and extended spool sheets (as applicable) with a cross-reference to any NDE report numbers.

2.1.8.4 Any piece of material not readily identifiable during fabrication shall be rejected, including other components welded thereto.

2.1.8.5 Deleted

2.1.9 Damaged Materials

2.1.9.4 The Supplier shall not make any base metal material repairs using welding.

3 Execution

3.1 Fabrication

3.1.2 Weld Joint Preparation

3.1.2.2 Do not use backing rings.

3.1.7 Flanges

Furnish flanges for flanged connections in accordance with the piping material classes and as shown on design drawings.

3.1.7.1 All slip-on flanges shall be double welded in accordance with paragraph 328.5.2 of ASME B31.3 unless directed otherwise by design document(s).

3.1.10 Valves

3.1.10.1 Install all valves in accordance with the manufacturer's recommended instructions and design drawings. BUYER shall furnish valve manufacturer's installation/disassembly instructions for Supplier's use and reference. The Supplier shall notify the BUYER if they have not been sent the applicable valve manufacturer's installation/disassembly instructions.

3.1.10.2 In addition to manufacturer's instructions, the following apply for valve installation:

3.1.10.2.1 Valve stems shall be positioned in accordance with the isometric and is normally not be inclined below the horizontal. Also, flow arrows, when present on the valve, must align with the flow arrow shown on the isometric.

3.1.10.2.2 Before conducting any welding on diaphragm valves or other soft-seated valves, the bonnet assembly and diaphragm, and any other heat-sensitive components shall be disassembled and valve body cooled, if required by vendor instructions. Particularly for stainless steel valves, care shall be exercised to ensure that contact with cooling medium (e.g., water-soaked wick) is not harmful. Water used for cooling of stainless steel valves shall have a maximum chloride content of 200 ppm.

3.1.10.2.3 To prevent damage or distortion to valve seat and disc, follow the vendor's instructions with respect to position of the valve stem and the disc during installation and welding.

3.1.10.2.4 If disassembly beyond the vendor's standard installation instruction is required, valves and actuators shall be disassembled and reassembled only after documented concurrence has been obtained from the BUYER that doing so will not compromise the warranty and performance of the valve.

3.1.10.2.5 Manual valves shall be disassembled and reassembled, if required, in accordance with the manufacturer's disassembly and reassembly procedures.

3.1.10.2.6 Valves shall be handled and supported with care to preclude damage to handwheels and appurtenances. Lifting lugs shall be used whenever they are provided on a valve. In no case shall a valve be picked up by the valve actuator.

3.1.11 Rework of Fabricated Spools

3.1.11.1 Reworked spools being shipped to the jobsite shall be provided with a Certificate of Conformance (C of C) stating the spools identified are the same spool number(s) originally delivered and received. The C of C shall state that the re-worked spools are in strict accordance and fully comply with the purchase order and all procedures and specifications. The C of C shall also state the re-work performed on each spool.

If additional materials are added, or if additional documentation is provided (NDE reports, MTRs, etc.) a complete documentation package for that spool shall be furnished.

3.2 Inspection and Testing

3.2.1 General

3.2.1.1 The Supplier is responsible for nondestructive examination and testing of piping furnished under this specification.

3.2.1.2 All examination, inspection, and testing shall be in accordance with this specification and other governing codes and standards, as applicable. This includes nondestructive examination of the piping spools in accordance with the requirements for Normal Fluid Service piping in ASME B31.3-96.

3.2.1.3 BUYER's representative shall be provided free access to the Supplier's and Supplier's subcontractor's or Supplier's facilities, to witness, inspect, and report progress of work.

3.2.1.4 Note: No sub-supplier shall perform NDE work without prior submittal of the sub-supplier's NDE procedure and BUYER's review and permission to proceed.

3.2.2 Examination of Fabrication Welds

3.2.2.1 Examine all completed pressure boundary welds in accordance with the ASME B31.3-96 and/or standard, including the requirements listed below, as applicable. Weld repair shall be examined according to the requirements used for the original weld.

3.2.2.2 Perform and evaluate examinations in accordance with procedures and acceptance standards prepared in accordance with the ASME B31.3-96 and/or standard, and the *ASME Boiler & Pressure Vessel Code*, Section V.

Summary Table of Non-Destructive Examinations (NDE) of Pipe & Tubing Shop Welds

Table 2 Piping Weld Examination Requirements

See sections 3.2.2.2 for applicable shop weld NDE, inspection, and acceptance criteria requirements.

Type of Weld	Piping Outside Black Cells and Hard-To-Reach areas
All Girth and Miter Welds	100% VT 5% RT or 5% UT
All Pipe and Integral Attachment Fillet Shop Welds - including thermowell socket welds, integral support welds, non pressure & non load bearing piping attachment welds	100% VT
All integrally reinforced forged branch fittings welded to main piping run.	100% VT

Legend: VT = Visual Examination per ASME B31.3 para 344.2
RT = Radiographic Examination per ASME B31.3 para 344.5
UT = Ultrasonic Examination per ASME B31.3 para 344.6
PT = Liquid Penetrant Examination per ASME B31.3 para 344.4
MT = Magnetic Particle Examination per ASME B31.3 para 344.3

ATTACHMENT AFPS

LAW TCO CUSTOMIZED AFPS

Per 24590-WTP-3PS-AFPS-T0001, Rev. 4

ENGINEERING SPECIFICATION FOR SHOP APPLIED SPECIAL PROTECTIVE COATINGS FOR STEEL ITEMS AND EQUIPMENT

Only the sections and appendices contained in this Attachment AFPS apply to the LAW Thermal Catalytic Oxidizer/Reducer (TCO). For continuity and maintaining configuration control, the section numbers from the AFPS specification noted above have been retained. Additional clarifications have been added to Sections 1.1 and 6.4.1, identified by an asterisk.

1 Scope

1.1 This specification defines the minimum requirements for Special Protective Coating (SPC) materials/coating systems, surface preparation, application, and inspection of protective coatings to be shop applied. Items and surfaces to be coated shall be coated in accordance with Appendix D of this specification. Unless indicated otherwise in the base technical specification/material requisition or purchase order, all coats will be shop applied. Finish color shall be *ANSI 70 Gray unless indicated otherwise in Section 2.0 of the Material Requisition (MR).

1.2 All Special Protective Coatings (SPC's) are designated as Commercial Grade (CM) and non-safety.

2 General

2.1 Responsibility

2.1.1 The SELLER shall supply all personnel, coating materials and all necessary surface preparation, application, inspection and other equipment as required.

2.1.2 The SELLER shall unload, inspect, and store all inbound steel items and equipment scheduled for coating when manufactured by others. Items found to be damaged or otherwise unsuitable for coating shall be identified and segregated for evaluation by the SELLER.

2.1.3 The SELLER shall store all coating materials, perform surface preparation, coating application and inspection in accordance with this specification and Buyer reviewed procedures. The coating systems and associated coating materials used shall be in accordance with Appendix D Coating Schedule or the Material Requisition (MR) when coatings are specifically identified.

2.1.4 The SELLER shall perform all inspections and tests contained in this specification as necessary prior to verification by the BUYER.

2.1.5 The SELLER shall provide application and inspection documentation for all coating Work in accordance with this specification.

2.1.6 The SELLER shall provide environmental control equipment as necessary for coating application and curing.

2.1.7 The SELLER shall provide erection marking. Marks for color-coding of bulk materials and erection marking shall be fully compatible with the coating system specified.

2.1.8 The SELLER shall touch-up and repair defective or damaged coating in accordance with procedures submitted and reviewed by the BUYER.

2.1.9 The SELLER shall protect all coated surfaces prior to shipment and provide suitable coverings, padding and strapping to protect coated items during shipment.

2.1.10 The SELLER shall only use inspection equipment that is currently (in date) calibrated.

2.2 Surfaces Not To Be Coated

2.2.1 Hold back coating from weld areas-

2.2.1.2 Three (3) to Four (4) inches for **shop** welds when using epoxy or other types of organic coatings

2.2.1.4 Note - The above coating hold back dimensions are only for items previously coated prior to welding. These coating hold back dimensions do not apply to shop welds that will be coated after welding is completed. This Section of the shop coating spec does not have anything to do with coating cold back requirements associated with visual inspection of welds during hydro testing. Coating hold back requirements associated with weld inspection must come from the prevailing code.

2.2.1.6 The coating hold back shall be sufficient to expose the entire shop weld for visual inspection on items fabricated prior to coating.

2.2.2 Name and instruction plates, etc.

2.2.3 Rubber or similar nonmetallic parts.

2.2.4 Machined surfaces.

2.2.5 Non-Ferrous metals unless otherwise specified.

2.2.6 Stainless Steel surfaces, unless specifically required by the BUYER (areas where stainless steel is welded to carbon steel the coating overlap onto the stainless steel shall be approximately 1" or as otherwise specified.)

2.3 Definitions

2.3.1 Batch- A quantity of coating made in one production run. A unique batch number is assigned for each production run of the coating material, curing agent, zinc powders, fillers and thinner.

2.3.3 Dry Film Thickness (DFT)- The thickness of an applied coating, once dry or cured. Usually expressed in mils (each mil is 1/1000 of an inch).

2.3.4 Fish Eyes (cratering)- Formation of holes or visible depression in the coating film. Usually from a contaminated particle on the surface prior to applying the coating.

2.3.5 Holiday- A Pinhole, skip, discontinuity, or void in the applied coating film.

2.3.7 Mfg. Std. Coating- A manufacturers standard coatings system applied to off the shelf items or standard line items of routine manufacture that are not specifically manufactured for the WTP project.

2.3.8 NIST- National Institute of Standards and Technology.

2.3.10 Pinholes- Minute holes visible in the applied coating without magnification that appears to penetrate one or more layers of the coating film.

2.3.11 Profile- The surface roughness resulting from surface preparation by abrasive blasting or other authorized methods. (Refer to Section -7.3.6).

2.3.13 Sag- The running of freshly applied coating on a vertical surface due to being applied too thick. (Same definition for runs and drips)

2.3.16 Training and Certification- Training shall include an understanding of the specification, work procedures and manufacturers published instructions. Certification shall include a documented performance test demonstrating quality work verifiable by the BUYER. (Refer to Sections 4.8, 5.1.7, 7.1.2, and 8.1.1.1)

2.4 Safety

2.4.2 The SELLER shall comply fully with OSHA Hazard Communication Standard 29CFR 1910. Material Safety Data Sheets (MSDS) for all materials, including thinners and cleaning solvents, shall be obtained from the materials manufacturer and upon request made available, at the place and time of Work, for review.

2.4.3 The Volatile Organic Compound (VOC) content of all materials shall comply with Federal, State and Local or other Regulatory requirements.

3 Applicable Documents

3.1 Codes and Standards

The latest applicable edition of the following codes, standards, specifications or WTP procedures form a part of this specification.

3.1.1 American Society for Testing and Materials (ASTM)

ASTM E337- R96; 02	Test for Relative Humidity by Wet-and-Dry Bulb Psychrometer
ASTM D3276- 00; 05	Standard Guide for Painting Inspectors (Metal Substrates)
ASTM D4285- 99	Test Method for Indicating Oil or Water in Compressed Air
ASTM D4417- 99; 03	Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D4537- 96; 04; 04a	Standard Guide for Establishing Procedures to Qualify and Certify Inspection Personnel for Coating Work Inspectors in Nuclear Facilities.
ASTM D4940- 98; 03	Test for Conductimetric Analysis of Water Soluble Ionic Contaminants of Blasting Abrasives
ASTM D5064-01	Standard Practice for Conducting a Patch Test to Assess Coating Compatibility

3.1.2 The Society for Protective Coatings (SSPC)

SSPC-AB1 6/1/97;7/1/07	Mineral Slag Abrasive
SSPC-PA2 5/1/04	Measurement of Dry Paint Thickness with Magnetic Gages
SSPC-SP1 11/1/82;11/1/04	Solvent Cleaning
SSPC-SP10 11/1/04	Near White Metal Blast Cleaning
SSPC-SP11 11/1/87; 11/1/04	Power Tool Cleaning to Bare Metal
SSPC-VIS 1 6/1/02; 11/1/04	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning

3.1.3 Occupational Safety and Health Administration (OSHA)

OSHA 29 CFR 1910	Occupational Safety and Health Standards

4 Submittals

4.1 SELLER shall prepare detailed written procedures for material receiving, marking, storage, handling, surface preparation, environmental control, application, curing, inspection, testing, touch-up/repair, application personnel qualification, inspector qualification, (G321- E , category 28.0) and proposed documentation forms as described within this specification. The final procedure and documentation forms shall be submitted and

reviewed with BUYER's permission to proceed prior to the start of coating Work. (G321-E category 15.0). Submittal requirements for manufacturers standard coating are found in Section 6.0.

4.2 The SELLER shall submit all procedures and verification documents in accordance with the purchase order (e.g., Appendix J, Form G-321-E. & V, Exhibit "D" located in the purchase order.).

4.4 The SELLER shall identify the specific products by manufacturer and catalog number and shall submit the coating manufacturer's latest published product data sheet, application instructions and Material Safety Data Sheets (MSDS). Conflicts, if any, between the SELLER's normal procedures, the coating manufacturer's recommendations, and this specification shall be brought to the attention of the BUYER for resolution and written permission to proceed. (G321-E category 11.0)

4.5 The SELLER shall submit original or copies of original Coating Manufacturer's Product Identity Certification Records for each and every batch of coating material used on the WTP project (Appendix F). (Refer to G321V category 13.0)

4.6 The SELLER shall submit a daily inspection record as part of the Work procedures that includes all the elements provided in Appendix G as a minimum. An entry for Wet Bulb is not required when the accepted device used to measure humidity and dew point does not require a wet bulb. (Refer to Section 8.1.9 and 10.2) (G321V category 15.0)

4.8 The SELLER shall provide a personnel training and certification plan for applicators and inspectors. (Refer to Section 2.3.16, 5.1.7, 7.1.2 and 8.1.1.1.).

5 Quality Plan

5.1 General

5.1.1 The SELLER shall control the quality of items and services to meet the requirements of this specification, applicable codes and standards, associated procurement documents, referenced herein. The SELLER shall prepare and maintain documentation to provide evidence of compliance with reviewed procedures and this specification. A copy of the coating inspection documentation shall be included in the shipping documentation.

5.1.2 The SELLER, including any lower-tier organizations engaged by him, shall be subject to surveillance inspection by the BUYER representative until completion or termination of the procurement. This surveillance inspection does not relieve the SELLER from the responsibility for conformance to the requirements of procurement documents, this specification and authorized procedures.

5.1.4 The BUYER representative shall be provided with a work activity schedule and shall be notified of all required inspection points prior to the scheduled date for coating activities (Refer to MR Section 5.0).

5.1.5 If the SELLER's proposed Work plan or procedures differ from the requirements of this specification, the SELLER shall specifically identify and explain all differences in writing and submit them to the BUYER for review and verification prior to the start of Work (e.g., Supplier Deviation Disposition Request-SDDR).

5.1.6 All pre-established witness and hold points shall be witnessed by the BUYER unless a written waiver has been issued.

5.1.7 The SELLER's coating inspectors shall have previous experience in coating inspection and shall receive documented training in the specific project coating requirements, ASTM standards and other relevant standards including the reviewed work procedures. All coating inspectors working on steel items or equipment shall be trained and qualified meeting the requirements of Section 8.1.1.1.

6 Materials

6.1 Coating Materials

6.1.2 Coating materials including the primer, intermediate and finish coat on a given item, shall all be from the same manufacturer. One exception to this rule is when upgrading a Manufacturer's Standard (Mfg. Std.) coating using a compatible epoxy tie-coat and suitable topcoat coating system (refer to Section 6.2).

6.1.3 Appendix D Coating Schedule and Appendix C Tables contain the specified Special Protective Coatings for the WTP project. Appendix C contains the generic coating systems and approved coating materials.

6.1.4 Repair materials shall be the same as those originally used. Repair materials shall be in pre-measured units, and only complete kits shall be mixed. Splitting or breaking down pre-measured units of multi-component coating materials may be considered if the SELLER prepares a procedure that requires accurate measurement of all materials and Seller's QC inspector monitoring/verification of each and every mix. This procedure must be submitted to the BUYER for review and permission to proceed.

6.2 Manufacturer's Standard Coating

6.2.1 Components and equipment which are normally mass-produced, inventoried, and supplied from stock generally have been coated with the Manufacturer's Standard Coating (Mfg. Std.) system. Included are small valves, pumps and rotating equipment, filters and electrical equipment such as switchgear, control panels, instrumentation, motors, transformers and electrical enclosures. Items and equipment which are specifically fabricated for the WTP project shall be coated per this specification unless the item is shown to be too delicate to properly coat per Appendix D or the specific requirements contained in the MR.

6.2.1.1 The SELLER may submit an alternate coating to the specified or Mfg. Std. System, by identifying the coating materials, surface preparation, application and inspection on Appendix H including the coating material's latest published technical data sheet and MSDS, to the BUYER for review and permission to proceed.

6.2.1.2 All Mfg. Std. coatings must be identified on an Appendix H and submitted to the BUYER along with technical data sheets and MSDS'. A small, easily replaceable item where coating touch-up is not practical (e.g., very small, too delicate, low cost and easily replaceable) and can only be purchased with the manufacturer's standard coating, an Appendix H Manufacturer's Standard Coating Data Sheet is not required.

6.2.1.3 Deleted

6.3 Machined-Surfaces Coating

6.3.1 Machined surfaces not specified to be coated with a specific coating system shall be protected with a solvent cutback asphalt temporary preservative (Daubert Chemical Tectyl 891, EF Houghton Chemical Rust Veto 342 or authorized equivalent). Temporary preservative applied to carbon steel that is overlapped onto stainless steel must meet the same chemical requirements as listed in Section 6.4. All equivalents must be identified on an Appendix H form and submitted along with the manufacturer's latest published data sheet and MSDS for review and permission to proceed by the BUYER.

6.4 Coating Over Stainless Steel

6.4.1 All coating materials, thinners, solvents and cleaning materials used on SS shall be shown to comply with the following requirements:

Leachable halogen content shall not exceed 200 ppm

The total sulfur content shall not exceed 400 ppm

The total of low melting point metals such as lead, zinc, copper, tin, antimony and mercury shall not exceed one (1) percent. Of this, mercury should not exceed 50 ppm. These low melting metals shall not be intentionally added during the manufacture of the coating.

* (ADDED for LAW TCO MR): Sherwin Williams Macropoxy 646 and Carboline Carboguard 890 have been tested and meet the requirements above. Only these materials are approved for direct contact with stainless steel.

6.5 Batch Information

6.5.1 Each container of coating material used by the SELLER shall be marked with the following:

- The manufacturer's name
- The product designation
- Batch or lot number
- Location and date of manufacture
- The shelf life expiration date

6.6 Abrasives

6.6.1 Abrasives for blast cleaning shall be clean, free of oil or contaminants, and dry. The particle size shall be capable of producing the specified surface profile. Mineral and slag abrasives shall meet the requirements of SSPC AB-1. The first batch/lot of bulk, non-packaged, abrasives shall be tested for water-soluble contaminants and the conductivity shall not exceed 500 micro siemens/cm when tested in accordance with ASTM D4940. As an alternate, a chloride ion test kit, such as the Chlor*Test "A" manufactures by Chlor Rid International Inc, or BUYER accepted equal may be used. The maximum allowable chloride level is 200ppm.

6.6.2 When using reclaimed steel grit/shot abrasive, the particle size shall be capable of producing the specified angular surface profile (minimum 50% steel grit in original mix and all adds shall be 100% steel grit). Reclaimed abrasives already in use and the first batch/lot of new abrasive shall be tested for water-soluble contaminants and conductivity. Conductivity shall not exceed 500 micro siemens/cm when tested in accordance with ASTM D 4940. As an alternate, a chloride ion test kit, such as the Chlor*Test "A" manufactures by Chlor Rid International Inc, or BUYER accepted equal may be used. The maximum allowable chloride level is 200ppm.

7 Application

7.1 General

7.1.1 It shall be the SELLER's responsibility to stop the surface preparation and coating at any time when conditions exist that might adversely affect the quality. The BUYER representative may reject any prepared or coated surfaces not in compliance with this specification.

7.1.2 All painters (e.g., surface preparation personnel and paint/coating material application personnel), shall be individually qualified and certified in accordance with the SELLER's written description that includes classroom training and capability demonstration using the WTP project specification, and the SELLER's procedures as reviewed by the BUYER.

7.1.3 Care shall be taken to avoid blasting or grinding away critical markings, which identify welders, joint numbers, or other markings, which identify the item. Where such data appears in the area to be coated, it shall be protected. SELLER's are responsible for assuring their Sub-Suppliers are instructed concerning these requirements.

7.2 Pre-Surface Preparation

7.2.1 Prior to mechanical cleaning, the surfaces to be coated shall be cleaned in accordance with SSPC SP1 to remove oil, grease, dirt, and other foreign matter that can interfere with the proper bonding of the coating. Any remaining sharp edges, weld spatter, or burrs found after the start of coating Work shall be completely removed by grinding or other means. Pneumatic tools shall not be used unless they are fitted with effective oil and water traps on the exhaust air. If the steel items or equipment was shipped or stored so that the surface could have been contaminated with soluble salts (e.g., above deck ship transport, truck transport on dirt roads close to ocean, storage), the area shall be pressure water washed (2,000-5000psi) with demineralized water to remove as much soluble salt contamination as possible prior to abrasive blasting.

7.3 Surface Preparation

7.3.1 Prior to the start of Work, the SELLER shall examine all surfaces to be coated to determine their acceptability for the specified coating application. If the surfaces are found to be unacceptable, the SELLER shall return the surface to an acceptable condition. Coating work shall not commence until corrective action has been taken. Commencement of coating work prior to the taking of correctable action shall preclude any subsequent claim by the SELLER. The BUYER may require corrective action at the SELLER's expense.

7.3.2 Prior to blast cleaning items to be coated, they shall be visibly dry with the surface temperature of at least 5°F above the dew point. When using automatic blasting equipment that recycles steel abrasive, the steel need only be visibly dry.

7.3.3 All surfaces to be coated shall be pre-cleaned per SSPC SP 1 where oil, grease, and other contaminants are present.

7.3.4 Abrasives shall meet the requirements of Section 6.6.

7.3.5 Surfaces to be coated shall be blast cleaned in accordance with the surface preparation requirements specified in Appendix D (e.g., SSPC SP10). Where abrasive blasting will damage the items or is impractical, SSPC-SP11 Power Tool Cleaning to bare Metal may be substituted only in limited areas and only with BUYER's permission to proceed (e.g. SDDR).

7.3.6 Abrasive blasting carbon steel shall result in an angular surface profile 1.5 to 3.0 mils deep as measured using a profile comparator or Testex Press-O-Film replication tape, in accordance with ASTM D4417 method A or C.

7.3.6.1 Methods established for measuring surface profile produced by abrasive blast cleaning are not valid or conclusive on surfaces that are excessively rough prior to blast cleaning (e.g. rough mill finishes, heavy rusting or pitting [SSPC-VIS 1 Condition D or rougher], cast surfaces, weld beads or physically damaged surfaces). Therefore, to accurately determine the surface profile produced by blast cleaning, profile measurements shall be taken in areas exhibiting the least surface roughness. For example, SSPC-VIS 1 pre-blast Conditions A, B or C typically result in a blasted surface that is acceptable for surface profile measurement.

7.3.6.2 If excessive surface roughness covers the entire item, then a smooth, clean ASTM A36 steel plate (e.g., SSPC-VIS 1 Condition A, B or C), approximately 6" square and at least 1/4" thick, shall be blasted using the identical abrasive, pressure, nozzle, blasting equipment and method used on the actual item. The surface profile measured on the smooth plate is regarded as an accurate measurement of the profile produced by that blasting method, and shall be recorded as the surface profile for the actual item. A new plate shall be blasted and measured at a frequency accepted in the SELLER'S procedures (refer to Section 8.1.9).

7.3.7 Recycled abrasive blasting using a steel grit/shot mix is acceptable. The maximum amount of shot in the original mix shall be 50%. All additions of abrasive shall be steel grit. The stabilized working mix shall be maintained by frequent small additions of new grit abrasive commensurate with consumption.

Infrequent large additions of grit shall be avoided. Steel grit or shot is not acceptable for use on stainless steel surfaces.

7.3.7.1 The working abrasive mix shall be maintained clean of contaminants by continuous effective operations of cleaning machine scalping and air wash separators. Reclaimed grit used for abrasive cleaning shall be tested for the presence of oil/grease by immersing a sample in clean tap water and checking for oil flotation. Tests shall be made at the start of blasting and at a minimum of every four (4) hours thereafter. If oil is evident, the contaminated abrasive shall be cleaned or replaced. All surfaces blasted since the last successful test shall be completely cleaned of contamination then re-blasted using clean abrasive.

7.3.8 Blast cleaning shall not be performed in the immediate area where coating or curing of coated surfaces is in progress. All surfaces and equipment, which are not to be coated, shall be suitably protected from blast cleaning.

7.3.9 Burrs, slivers, scabs, lamination, and weld spatter which become visible after blasting shall be removed. The tools and manner employed to remove weld defects and sharp edges shall not burnish or destroy the profile. If the profile or roughness is reduced, it shall be re-blasted to produce the profile and roughness as required. The exhaust of pneumatic grinders shall not impinge on the cleaned surface. If the surface becomes contaminated, it shall be cleaned of contamination and re- blasted. Carbon steel tools or implements specifically employed for coating surface preparation shall not be used on stainless steel surfaces.

7.3.10 If visible rust occurs or if the cleaned surface becomes wet or otherwise contaminated, these surfaces shall be re-cleaned to the degree specified. Cleaned surfaces remaining uncoated overnight shall be visually reinspected 100% for required cleanliness prior to coating or shall be re-cleaned to the specified cleanliness prior to applying the coating.

7.3.11 After surface preparation is complete and before coating, pressurized air or a vacuum shall be used to remove all dust and abrasive residue. The air shall be clean and dry as verified in accordance with Section 8.1.6 so as not to contaminate the prepared surface.

7.3.12 Machined surfaces shall be wiped with clean solvent before the application of coating and shall be protected from damage due to blasting and coating operations.

7.3.13 Machined portions of pipe flanges and other machined mating faces which will not be exposed after final fit-up shall be masked or covered and protected from surface preparation and coating activities. The remaining part of the flange face and exposed surfaces shall then be blasted and coated (bolt holes need only to be sufficiently coated for visible coverage. No dry film thickness required.).

7.3.14 Equipment shall have all openings plugged, masked, and/or blinded sufficiently to protect internals before abrasive blasting. After the coating operation is complete all internals shall be blown clean and/or vacuumed to remove any dust or abrasive blast media that may have entered the coated equipment.

7.3.15 The abrasive mixture and the compressed air shall be clean, dry and oil free. Moisture traps, in addition to oil and water extractors mounted on the compressor, shall be used in compressed air lines to remove oil and moisture from air close to the point of use. (Refer to Section 7.3.7.1 and 8.1.6)

7.3.16 All valves, valve actuators and motors that will be shop coated shall be blasted and coated prior to assembly. Areas of assembled items that are not coated prior to assembly and subject to damage during blasting must be carefully protected from abrasive damage or abrasive contamination.

7.4 Coating Application

7.4.1 The coating shall be applied in accordance with reviewed procedures (refer to Section 4.1). The coating manufacturer's recommendations for the application temperature and the curing temperature and times (between coats and after last coat) of the specified material shall become a part of this specification.

Application and curing temperatures above or below the limits allowed by this specification (Refer to Section 7.4.4) shall be submitted to the BUYER for review (e.g., SDDR).

7.4.2 Coatings shall be applied using properly sized and type of equipment for the size & complexity of the item being coated. The equipment shall be clean with all components in good working order.

7.4.3 Surfaces that will become inaccessible shall be coated before assembly, tagging, fitting, or welding. Inaccessible surfaces includes lap joint flanges, nozzle necks, lap joint stub ends, lap rings, bolt holes, flanges for exchangers and vessels, and welded joints that become inaccessible after assembly.

7.4.4 Coatings shall be applied only when the surface to be coated is clean and dry. The substrate temperature shall be a minimum of 5°F above the dew point during coating application and until the applied coating is no longer moisture sensitive per the coating manufacturer's published data or written recommendations. The substrate and air temperature during coating application and curing shall be a minimum of 50°F (Inorganic zinc primers 40°F) and a maximum of 110°F. The relative humidity during coating application shall not exceed 85 percent. Measure humidity in accordance with ASTM E 337 (Sections 1.0-19.0) or using an alternate method reviewed and accepted by the BUYER. Deviations from the above listed minimum and maximum substrate/air temperature and humidity limits may be allowed when in accordance with the coating manufacturer's published or written recommendations and are accepted by the BUYER. The one firm limit is that the minimum substrate or air temperature shall not be less than 35 °F regardless of the coating manufacturer's published or written recommendations.

7.4.5 The SELLER shall record all batch numbers for each coating component used along with other information necessary for the BUYER to relate the batch to the item for which it was applied. (Refer to Appendix G)

7.4.6 All coatings shall be thoroughly mixed until they are smooth and free from lumps, then strained through a screen of at least 30 mesh. Zinc filled coatings shall be continuously agitated from the time initially mixed and while being applied. Other coating materials shall be mixed in accordance with the coating manufacturer's published recommendations. All multi-component coating materials shall be in pre-measured units. Splitting or breaking down pre-measured units is not permitted. See Section 6.1.4 for requirements for mixing repair materials.

7.4.7 Alternating coats shall have a visible color difference to insure full coverage over previous coats. Touch-up of individual small spots < 6 sq. in, do not require a visible color difference when individually marked for repair and the mark remains in place until the repair is accepted.

7.4.8 Dry film thickness of each coating shall be in accordance with Appendix C/Table 1 Acceptable Coating Materials or as specified in the MR. (Refer to Section 8.3.2 & 8.3.3).

7.4.9 Relative to the ambient and surface temperatures the minimum and maximum drying times between coats shall be in strict accordance with the coating manufacturer's latest published technical data sheets.

7.4.10 Runs, sags, voids, drips, overspray, loss of adhesion, bubbling, peeling, or inadequate cure are not permitted. Where possible, defects shall be corrected as detected during application of the coating.

7.4.11 Spray equipment, brushes and rollers shall be cleaned using only manufacturer recommended solvents/cleaners.

7.5 Remedial Work

7.5.1 The completed coating on each item shall have the correct dry film thickness and shall be free of damage and visible defects.

7.5.2 Repair of Dry Film Thickness (DFT) deficiencies

7.5.2.1 Defects such as runs, sags, overspray and embedded particles shall be corrected by sanding to remove the defect. When the defects are in the finish coat, all areas sanded must be overcoated with the finish coat. If the DFT of primer or intermediate coat is reduced to less than the specified

minimum, the area shall be abraded with 80 grit sand paper or flapper wheel and an additional layer of coating shall be applied until sufficient thickness is achieved. If noticed during application, the sags or runs may be brushed out.

7.5.3 Repair of Damage

7.5.3.1 All damaged and loosely adhering coating shall be removed and the surface thoroughly cleaned using 80 grit sanding disc, 80-grit flapper wheel or 3M Clean-N-Strip. Edges of the breaks shall be feathered and the resulting surfaces shall be roughened. The designated number of prime and finish coats shall be applied.

7.5.4 Loss of adhesion, delamination blisters, bubbling and fish eyes in the applied coating require the coating to be removed and reapplied in accordance with this specification.

8 Inspection

8.1 General

8.1.1 The SELLER shall have the full responsibility for the coating application quality in accordance with this specification and shall be responsible for stopping Work activities when conditions develop that could adversely affect the quality of the completed work. All Work is subject to the BUYER's inspection surveillance.

8.1.1.1 All coating Work inspection personnel shall be trained, qualified and certified in accordance with the SELLER's reviewed procedures. The inspectors shall meet or exceed the minimum capability requirements for a Level I coatings inspector as described in ASTM D4537 Section 6.2. The SELLER's inspector training, qualification and certification procedures and plan shall include classroom training on the WTP project specification, and the SELLER's reviewed procedures using the guidelines provided in ASTM D5498. The SELLER's inspector must demonstrate his/her capability of using the inspection equipment and performing all the required inspections. Additional coating work inspection guidance is found in ASTM D3276 and ASTM D6237 which may also be used in developing procedures for training and certifying coating work inspectors.

8.1.2 The BUYER representative shall be the final authority on the specification compliance for surface preparation and material application. Any coating, which in the BUYER representative's judgment, has not been applied in conformance with this specification, shall be rejected.

8.1.3 The BUYER representative shall have access to each part of the process and shall have the right and opportunity to witness any of the Quality Control Tests.

8.1.4 The SELLER shall furnish the necessary testing and inspection instruments, properly calibrated and maintained. If equipment is suspected of being out of calibration, it shall be re-calibrated and certificates made available for verification to the BUYER. Such equipment shall be available for use by the BUYER in conducting surveillance of the work. Calibration of testing and Inspection instruments shall be traceable to NIST or Buyer authorized alternative standards.

8.1.5 The SELLER shall halt the coating Work and make corrections to the procedures, as necessary to correct repetitive faults found in the Work.

8.1.6 Prior to using compressed air, the quality of the air downstream of the separator shall be tested in accordance with the requirements of ASTM D4285 by blowing the air onto a clean white blotter or cloth for two (2) minutes at a distance of no more than (12) inches to check for any contamination, oil, or moisture. "This test shall be performed at the start of work and every 4 hours thereafter". The test shall also be made after any interruption of the air compressor operation or as required by the BUYER. The air shall be used only if the test indicates no visible contamination, oil, or moisture. If contaminants are evident, the equipment deficiencies shall be corrected and the air stream shall be re-tested. Moisture separators shall be bled continuously. All lines shall be tested individually prior to use. Surfaces

determined to have been blown down or blasted with contaminated air shall be cleaned of all contamination then re-blasted with clean air and abrasive. Coatings determined to have been applied using contaminated air shall be removed and reapplied using clean air.

8.1.7 Inspection points shall be established as follows:

- Prior to the start of Work.
- Immediately following the surface preparation
- Immediately prior to the coating application
- Following the application of each coat
- Following the curing of the coating
- Final inspection and sign-off, in accordance with the project requirements

8.1.8 Any defects disclosed by inspection shall be re-inspected after correction.

8.1.9 The SELLER shall keep the records indicated below, and submit these records to the BUYER (refer to Section 4.6 and Appendix G). The following lists the frequencies:

Coating/Inspection Step		Required Frequency
1.	Pre-Surface Prep Surface Preparation Profile	100% visual on Pre- Surface 100% on Surface Prep/Cleanliness Profile first item of each type per shift and every 20 items thereafter or other frequency as BUYER accepted in SELLER's procedures.
2.	Environmental/Air Quality	At the start of each work and every 4 hours thereafter or more often during changing conditions.
3.	Recirculated Abrasive	At the start of work and every 4 hours thereafter
4.	Thickness Per SSPC PA2	On large items five (5) spot reading per 100 sq.ft. On items < 100 sq.ft. four (4) spot readings On items less than 4" (valves, fittings, components, etc) two (2) spot readings, For repair spots < 6 sq. inches and > 1 sq. inch. Two (2) spot readings For repair spots < 1 sq. inch one (1) spot reading For small chips/nicks/scratches and pinhole size repair spots need only a visual. For complex surfaces such as structural steel (steel beams) the frequency of dry film thickness readings shall be in accordance with SSPC-PA2 Appendix 3 section A3.4.1 excluding any readings on the flange toes. In accordance with figure A.3 "The Surface of a Steel Beam" the following locations are acceptable for the test readings- 1, 3, 4, 5, 7, 9, 10 and 11; and the following locations are excluded from test readings- 2, 6, 8, 12. For beams less than 20'-0" two (2) sets of 8 spot readings shall be taken.

		For beams 20'-0" thru 60'-0" three (3) sets of 8 spot readings shall be taken.
5.	Visual on Applied Coating.	100% of all items

8.2 Surface Preparation Inspection

8.2.1 Verify environmental conditions and compressed air quality (refer to Section 7.3.2, 8.1.6).

8.2.2 Verify recirculated grit is grease and oil free (refer to Section 7.3.7).

8.2.3 Verify surface cleanliness and profile (refer to Sections 7.3.5, 7.3.6 and 8.1.9).

8.2.4 Grease free chalk shall be used to mark local areas, which do not meet the specified requirements (e.g., soapstone and crayons are not acceptable).

8.3 Coating Application

8.3.1 Environmental conditions and compressed air quality shall be verified per Sections 7.3.2, 7.4.4, 8.1.6 and 8.1.9.

8.3.2 Dry coating thickness (DFT) shall be measured with a magnetic film thickness gage such as an Elektro-Physik "Mikrotest" or Positector 2000, Positector 6000 or BUYER authorized equal in accordance with SSPC PA2. The number and location of dry film thickness readings shall be in accordance with section 8.1.9.4.

8.3.2.1 The gage shall have an appropriate range that is suitable to measure the thickness expected and record calibration accuracy in accordance with SSPC PA 2 at the start of work, against certified coating thickness calibration standards for non-magnetic coating of steel, traceable to NIST or BUYER authorized alternative standards. The calibration standards shall be in date, and 1.5 mil to 20.0 mil range, unless otherwise specified.

8.3.3 Any surface with a measured thickness outside of the limits described in Section 7.4.8 shall be rejected. These areas shall be reworked or re-cleaned and re-coated at the SELLER's expense. The average of the required number of readings shall be within the specified dry film thickness range. Any of the required spot readings may be as low as 80% of the minimum specified or 120% of the maximum specified as long as the average of all the readings is within the specified range. An individual spot reading that conforms to this criteria conforms to the specified dry film thickness.

9 Storage, Handling and Shipping

9.1 Coating Materials

9.1.1 Coating materials shall not be stored in direct sunlight or exposed to inclement weather (e.g. rain, snow, sleet, freezing rain, dew point condensation, see also Section 9.1.5). Materials shall remain under cover until ready to use.

9.1.3 Coating material shall be delivered in manufacturer's original unopened containers. Each container shall be clearly identified with the manufacturer's name, product designation, batch number, date of manufacture and shelf life expiration date.

9.1.4 The maximum shelf life allowed for coating materials used on the WTP project is 24 months from the date of their manufacture. Coating materials that are older than 24 months or that exceed the manufacturer's published shelf life, if less than 24months, shall not be used and shall be placed on HOLD and segregated from other coating materials. A one-time shelf life extension of no less than three (3) months and no more than six (6) months, may be issued by the coating manufacturer. The shelf life extension shall be based on

laboratory testing of retain samples taken at the time of manufacture or by testing a sample provided from the actual coating material in question. Where testing verifies an outdated coating material still complies with its original design criteria, it is acceptable for shelf life extension. Expiration date stickers, provided by the coating manufacturer, shall be affixed to each container prior to release from HOLD. The stickers shall include the product number, batch/lot number, the new expiration date and suitably marked to indicate that they came from the coating manufacturer. A new Appendix F shall be provided by the coating manufacturer that includes the test results and specifically indicates it was provided to document shelf life extension including new expiration date. Coating materials that have not been stored or handled in accordance with Sections 9.1.5, 9.1.6, 9.1.7 and 9.1.8, may not have their shelf life extended.

9.1.5 Coating material shall be protected from moisture, direct sunlight and temperatures below 40°F or above 100°F unless otherwise allowed by the coating manufacturer's latest published instructions and verified by the BUYER.

9.1.6 Coating material containers where the airtight seal has been broken or any of the contents are lost, shall not be used and shall be clearly marked and segregated from useable coating material.

9.1.7 Coating material containers shall not be opened except for immediate use.

9.1.8 Unused material shall be returned to storage as soon as possible at the end of each Workday. Materials left out for more than eight (8) hours in an uncontrolled storage area (areas without environmental controls that are exposed to ambient weather) shall not be used and shall be clearly marked and segregated from useable coating material.

9.1.9 All required coating material certifications (Appendix F forms) for each batch of material delivered to the SELLER shall be available at the time of material receipt. Materials delivered to the shop without the required documentation shall not be used and the SELLER shall tag and place discrepant materials into a hold area clearly separated from acceptable material. Once required documentation is received or otherwise corrected and found to be acceptable, the discrepant material may then be taken off hold status and used.

9.2 Steel Items and Equipment

9.2.1 The SELLER shall be solely responsible for the condition of the steel items and equipment from the time they are received until they have been delivered to the BUYER.

9.2.2 All booms, hooks, clamps, forks, supports, and skids used in handling or storing coated items shall be designed and maintained in such a manner as to prevent any damage to the items or to the coating and shall be reviewed by the BUYER's representative. Chains and wire rope in direct contact with the coated items are not acceptable. Fabric lifting and tie down straps shall be used.

9.2.3 The SELLER shall inspect all items upon receipt for shipping and handling damage. Any visible damage observed at this point shall be noted on the receipt inspection report.

9.2.4 All coated steel items and equipment shall be stored on padded supports as necessary to preclude damage to the coating. The supports shall be properly spaced and leveled.

9.2.5 The BUYER's representative will have authority to stop any storage or handling activity, if there is a possibility of damage to the coating.

9.2.6 All steel items and equipment damaged by the SELLER shall be repaired in accordance with the specification at the SELLER's expense. Only repair procedures reviewed by the BUYER shall be used.

10 Documentation

10.1 The SELLER shall provide a record of all materials used (related to individual batch number- refer to Appendix F).

10.2 The SELLER shall provide a record of all required daily inspections (Example- Appendix G) that includes pre-surface preparation, compressed air cleanliness, environmental conditions, surface preparation and roughness, location of field repairs coated, application, visual inspection, dry film thickness, holiday testing and all touch-up/repair. This record shall include the coating and thinner materials used and the ID of the items coated to provide traceability.

10.3 All quality documentation shall be available for review by the BUYER representative within 24 hours from the time it is generated.

10.4 SELLER documentation forms or the way that the actual Work will be documented shall be provided by the SELLER as part of the procedures submittal for review by the BUYER.

10.5 Documentation shall be submitted in accordance with the requirements listed in Section 3 of the Material Requisition (MR).

APPENDIX C
Coating Materials/Coating Systems

TABLE 1 - PREQUALIFIED COATING PRODUCTS

Coating Number	Generic Products	Dry Film Thickness (mils)	Ameron	Carboline	Devoe	Dudick	Inter-national	Sherwin Williams
P02	Organic Zinc Epoxy Primer	3.0-5.0	Amercoat 68HS	Carbozinc 859	313	None	Interzinc 52	Zinc Clad IV
P04	High Build Epoxy	4.0-6.0	Amercoat 385	Carboguard 890	224HS	Protecto-Coat 330 or 300	Intergard 475HS	Macropoxy 646

NOTES to Table 1, Appendix C:

1) All versions of the above coating materials shall comply the WTP project VOC requirements of 3.8 lbs./gal and shall also comply with more restrictive local VOC requirements where the work is being performed. In the event the listed coating materials or acceptable versions of the listed coating materials do not meet the local VOC requirements an alternate VOC compliant material may be submitted for review.

TABLE 2 – COATING SYSTEM CODES

SYSTEM CODE	D
COAT 1	P02
COAT 2	P04
COAT 3	P04
COAT 4	

NOTES to Table 2, Appendix C:

1) The surface preparation for all coating systems shall be SSPC SP10 Near White Blast with a surface profile of 1.5 to 3.0 mils unless otherwise noted in this specification or the material requisition.

Appendix D
Coating Schedule

No.	Item – Component	System Code	Surface Prep. SSPC		1st Coat	DFT in mils	2nd Coat	DFT in mils	3rd Coat	DFT in mils	Color
			Initial	Repair							
7.0	**Skid Mounted Equipment**										
7.10	Skid Mounted Equipment-interior	All items on the skid shall be individually coated.									
8.0	**Miscellaneous Steel Items and Equipment**										
8.20	Miscellaneous Mechanical Equipment-Interior	D	SP10	SP11	P02	3.0-5.0	P04	4.0-6.0	P04	4.0-6.0	ANSI 70 GRAY

NOTES TO APPENDIX D

5. Flange surface (except gasket surfaces) & boltholes shall be cleaned and coated the same as the adjacent component.
8. Individual components of skid-mounted units shall be coated as noted for each individual item listed in Appendix D.
9. Complete details of the Manufacturer's Standard coating system shall be submitted for review. Refer to Section 6.2.
18. To minimize the potential of cracking or chipping where bolts are torqued onto precoated surfaces and within the bolted connection itself, a three coat coating system may be reduced to the prime coat and one finish coat directly under the bolt head, washer and nut up to 1/2" beyond.

Appendix F

Coating Manufacturer's Product Identity Certification Record

Project Name: _____ Coating Manufacturer: _____

Project Number: _____ Purchase Order Number: _____

Project Location: _____ Contract Number: _____

Coating Applicator: _____ Generic Coating Type: _____

Product Name: _____ Product Number: _____

(For multi-component products, provide data for all components on one or more Appendix F forms).
(Provide the standard range and actual batch values for each test)

TEST RESULTS		**Component A Batch No.**		**Component B Batch No.**	
Test	**Test Method Used**	**Standard Range**	**Batch Actual**	**Standard Range**	**Batch Actual**
Weight per Gallon					
Viscosity					
Flash Point (Typical)					
% Solids by Volume (Typical)					
Cure to recoat time @ 50F, 70F, & 90F (typical)					
Batch Size					
Date of Mfg.					
Shelf Life					
Expiration Date					

COMMENTS:

I hereby certify that the coating materials described above were manufactured with the same formulation, raw materials, production methods, and quality control standards as the coating materials originally tested and/or accepted for use at the River Protection Project-Waste Treatment Plant (WTP) Project site, located in the 200 East Area of the Hanford Site in Washington State in accordance with the requirements of WTP specification 24590-WTP-3PS-AFPS-T0001, 24590-WTP-3PS-AFPS-T0003,24590-WTP-3PS-AFPS-T0004, 24590-WTP-3PS-AFPS-T0006 and 24590-WTP-3PS-PX04-T0004.

Signed: _____ Date: _____

Title: _____ Company: _____

Appendix G
Surface Preparation and Coating Inspection Form

Page __ of ___

REPORT NO:_____ DATE: _____
PROJECT:_____ DAY: M T W T F S S
SUBCONTRACTOR/SELLER:_____ SHIFT: _____
EQUIPMENT/AREA:_____ INSPECTOR: _____
SUBSTRATE: STEEL/CONCRETE/OTHER-_____ COATING SPEC NO/REV:_____
ENVIRONMENTAL CONDITIONS:

WORK ACTIVITY						
TIME						
DRY BULB TEMP. °F						
WET BULB TEMP. °F						
RH %						
DEW POINT °F						
SURFACE TEMP. °F						
BLOTTER TEST						

PRE-SURFACE PREPARATION:
SP-1:_____ MASKING/PROTECTION:_____ SURFACE DEFECTS:_____

SURFACE PREPARATION:
METHOD:_____ ABRASIVE TYPE/SIZE/STORAGE:_____
CLEANLINESS SPEC:_____ ACTUAL:_____PROFILE SPEC:_____ ACTUAL:_____
EQUIPMENT:_____

COATING MATERIALS & MIXING:
PRODUCT(S)_____
BATCH NO(S)/QUANTITIES/EXPIRATION DATE:_____/_____/_____
THINNERS/THINNING RATIO:_____/_____/_____
STORAGE:_____ MIXING: _____ INDUCTION TIME:_____
MATERIAL TEMPERATURE:_____ POT LIFE EXPIRATION TIME:_____
COATING/LINING APPLICATION START TIME:_____ FINISH TIME:_____
COAT: PRIMER/PRIMER T.U./SECOND/SECOND T.U./THIRD/THIRD T.U./OTHER
METHOD:_____ WFT:_____ RECOAT TIME/TEMP:_____ CURE TIME/TEMP:_____
EQUIPMENT:_____

APPLIED COATING:
VISUAL INSPECTION (FILM IMPERFECTIONS):_____
DRY FILM THICKNESS: SPEC:_____ ACTUAL:_____ METHOD:_____
HOLIDAY TEST:_____ METHOD:_____ OTHER TESTING:_____ METHOD:_____
TOUCH-UP AND REPAIR:_____ FINAL CURE:_____

COMMENTS: (*Use reverse side or attach extra pages*)

_____/_____
INSPECTOR'S SIGNATURE/DATE

Appendix H
Manufacturer's Standard Coating Data Sheet

The SELLER proposes the following Manufacturer's Standard (Mfg. Std.) or alternate coating system that is suitable for the exposure conditions of steel items and equipment in radiation and non-radiation areas.

1. ^**Equipment Description:** _____
   - A. Tag Number _____
   - B. Part(s) i.e. skirt, shell, channels, lugs, etc.* _____
   - C. Design/Operating Temperatures, designate °F or °C ..... _____ °F _____ °C
   - D. Does Equipment Receive Steam out (Yes/No), Temperature _____ °F _____ °C
   - E. Insulated/Uninsulated _____
   - F. Fireproofing (Yes/No) _____
   - ^G. Carbon Steel (CS), Stainless Steel (SS), other (List) _____
2. ^**Seller:** _____
3. ^**Surface Preparation:** SSPC No./Profile _____ / _____
4. **Coating System Designation:** (Code)

	First Coat	Second Coat	Third Coat
^A. Type of Coating			
^B. Coating Mfg./No.**			
^C. Dry Film Thickness (Min/Max in mils)/(μm) ...			
D. Wet/Film Thickness (Min/Max in mils)/(μm)			
E. Curing Method			
^F. Color			
G. Dry to Recoat			
H. Pot Life			
L. Thinner / %			

5. **Total DFT of System:** (Mils/μm)(Min/Max) ..... _____ / Min. _____ / Max.
6. **Material Storage:** Temperature Requirements (Min/Max) _____ / _____
7. **Shelf Life:** _____ Months
8. **Application Environmental Limits:**
   - A. Temperature Ambient and Surface (Min/Max) ..... _____ / _____ _____ / _____
   - B. Humidity (Min/Max) ..... _____ / _____
   - C. Surface Temp ≥5°F above Dew Point temp. (Yes/No) ..... _____
9. **Protection of surfaces that will be inaccessible after equipment installation (such as underside of base plates, interior of fans, vessels or equipment housings)** _____
10. **Rust Preventative for machined faces:** (**Mfg./No.) _____
11. **Quantity of touch-up coating supplied:** *None* _____
12. **Additional information:** (attach extra page as necessary) _____

* Use additional copies of this form for each part described in 1 above that requires a different coating system. A completed copy of this data sheet shall be submitted to CONTRACTOR/BUYER with the initial vendor data submittal.

** Include manufacturer's technical data sheets and MSDS for each proposed coating & preservative.

^ Mandatory data entry. Other entries should be completed where information is available from sub vendor or from coating material technical data sheets.

ATTACHMENT EEQ

LAW TCO CUSTOMIZED EEQ GUIDANCE

Environmental Equipment Qualification Requirements for SS-Chemical Toxicity Equipment in the LAW Facility

Environmental Equipment Qualification Requirements for SS-Chemical Toxicity Equipment

1. The equipment shall be designed under applicable codes and standards to withstand the effects of its environmental and process conditions and perform its safety function under the applicable Design Basis Event (DBE) conditions.
2. The Seller shall establish and document the ability of the supplied safety equipment to perform its safety function under the most severe environmental and process conditions to which it is subject during its installed life.

   The evaluation necessary for this purpose may be based on testing, analyses or operating experience. The necessary data shall have been obtained under quality assurance requirements imposed elsewhere in the procurement documents.

   The environmental service conditions considered shall be those contained in the Equipment Qualification Datasheets (EQD) applicable to the supplied equipment and are provided as part of the procurement documents. The process conditions considered shall be those stated in the equipment datasheets or elsewhere in the procurement documents.

   Testing performed to establish adequate performance under Design Basis Event (DBE) conditions, including Seismic testing, need not be performed on an aged test specimen.
3. The Seller shall consider the aging effects of the environmental and process conditions.

   The Seller shall consider the effects of temperature (thermal aging), radiation and wear as aging mechanisms. For radiation exposure evaluations, a total radiation dose of less than 1.0E03 Rad is not a significant radiation aging mechanism for electronic components. A total dose of less than 1.0E04 Rad is not a significant radiation aging mechanisms for organic compounds.

   The results of the aging evaluation shall be documented as recommended maintenance, replacement and/or surveillance actions which are required in response to the aging effects.

   The desired qualified life for the supplied equipment for the WTP is 40 years. However, if agreed to by the BUYER, the equipment/component qualified life may be less than 40 years.
4. Components not involved in the equipment's safety function(s) may be excluded from the Seller's qualification process if it can be shown, through a documented means such as analysis that assumed failures, including spurious operation, have no adverse effect on the stated safety function(s) or by way of interfaces, on the safety function(s) of other equipment.

5. The results of the qualification evaluations required above shall be specific to the equipment items supplied to WTP. Any modifications made to the equipment after the evaluations are complete shall also be evaluated in accordance with the above requirement and the results shall be similarly documented.. Modifications to the equipment include changes in its design, materials, manufacturing process, clearances, lubricant, or mounting conditions.
6. Documentation of Qualification
    a. The Seller shall provide a signed Certificate of Conformance to the specified performance requirements. The certificate shall be in the form shown in Attachment 11 of the primary specification 24590-LAW-3PS-MBTV-T0001, *Engineering Specification for LAW Thermal Catalytic Oxidizer/Reducer.*
    b. Passive Equipment
        i. The Seller shall provide a documented evaluation confirming that the applicable bounding normal, abnormal, accident and post accident environmental and process conditions will not degrade non-metallic component/subcomponent performance in such a manner as to prevent the equipment from performing its required passive safety function(s).
    c. Active Equipment (including all electrical, instrumentation and controls equipment)
    d. The Seller shall either: a) document recommended replacement (whole equipment or parts) or maintenance actions which are required in response to the aging effects and include a specific statement that the recommended replacement (whole equipment or parts) or maintenance actions are based on the aging considerations, or b) provide a statement that no maintenance / components replacements are required due to aging considerations if the equipment is not susceptible to aging,
    e. All qualification documentation shall be submitted to WTP under document category 35 of BNI Form G-321-E.

34.0 ANSI K61.1, American National Standard Safety Requirements for the Storage and Handling of Anhydrous Ammonia

Revision: 1999

Sponsoring Organization: Compressed Gas Association, Inc.

WTP Specific Tailoring

The following tailoring of ANSI K61.1 is required for use by the WTP project as an implementing standard for the safety related systems design.

Page 9; Section 5.1 Equipment and systems

Revise Section 5.1 as follows:

Not Applicable

Justification: Section allows the continued use or reinstallation of containers and systems designed and installed under earlier versions of codes and ANSI standards. WTP does not plan on using previously installed or design equipment. Therefore, Section 5.1 of this standard will not be implemented for this project.

Page 11; Section 5.2 Requirements for new construction and original test, repair, and alterations of containers (including DOT portable tanks), other than refrigerated storage tanks

Revise the first sentence of Section 5.2.2.2 as follows:

Steels used in fabricating pressure containing parts of a container shall not exceed a specified ASME Code Minimum Yield Strength of 70 ksi (483 MPa) (does not apply to Sections 8, 9, and 10).

Justification: Section 5.2.2 states that containers designed and construction in accordance with the ASME Code shall comply with the following requirements. In the wording of Section 5.2.2.2, the term "shall not exceed a specified tensile strength of 70 000 psi" is ambiguous.

ANSI K61.1 - 1989, paragraph 5.2.2.2 states that "Steels used in fabricating pressure-containing parts of a container shall have a tensile strength no greater than a nominal 70,000 psi (480 MPa) (does not apply to Sections 8, 9, and 10)." This paragraph is interpreted to mean that materials with a tensile strength range of 65,000 to 80,000 psi or 70,000 to 95,000 psi would be suitable for this fabrication. A material with a tensile strength range of 80,000 to 105,000 would not be acceptable.

CGA-2 - 1995, paragraph 18.2.1 states that "Steels used to fabricate the pressure-retaining parts of a container must not exceed 70,000 ksi **minimum specified tensile strength** in order to minimize the

potential for the development of stress corrosion cracks during service". Again, this paragraph is interpreted to mean that a material with a specified range of 70,000 to 95,000 psi would be acceptable for this fabrication.

ANSI K61.1 - 1999 / CGA G-2.1 - 1999, paragraph 5.2.2.2, states "Steels used in fabricating pressure containing parts of a container shall not exceed a specified tensile strength of 70,000 psi (483 MPa) (does not apply to Sections 8, 9, and 10)." Exception: Implements of husbandry may be fabricated from steel having a specified tensile strength of 75,000 psi (517 MPa)".

From the sequence of the code issue dates, it appears that the CGA recognized the ambiguity of the word "nominal" when referring to the tensile strength in ANSI K61.1 - 1989, Section 5.2.2.2, and corrected it in CGA-2 - 1995 to indicate the minimum specified tensile strength. In ANSI K61.1 - 1999 / CGA G-2.1 - 1999, Section 5.2.2.2, it appears that the CGA revised its terminology to be more consistent with the terminology used in the ASME codes for the specified tensile strength, which are the minimum tensile strengths. The purpose of tailoring Section 5.2.2.2 is to remove any ambiguity and provided consistency between the ASME Code and ANSI K61.1 -1999.

This tailoring is per DOE Letter 10-NSD-068 dated September 24, 2010 (CCN 225818).

Page 19; Section 6.3 Pressure relief devices

Revise Section 6.3.2 as follows:

Not Applicable

Justification: Section specifies relief valve design for underground containers. WTP does not plan to install underground containers. Therefore, Section 6.3.2 of this standard will not be implemented for this project.

Revise Section 6.3.3 as follows:

Not Applicable

Justification: Section specifies manhole design for relief for underground containers. WTP does not plan to install underground containers. Therefore, Section 6.3.3 of this standard will not be implemented for this project.

Page 19; Section 6.4 Installation of storage containers

Revise Section 6.4.4 as follows:

Not Applicable

Justification: Section specifies design requirements for the installation of underground containers. WTP does not plan to install underground containers. Therefore, Section 6.4.4 of this standard will not be implemented for this project.

Revise Section 6.4.5 as follows:

Not Applicable

Justification: Section specifies design requirements for the installation of underground containers. WTP does not plan to install underground containers. Therefore, Section 6.4.5 of this standard will not be implemented for this project.

Revise Section 6.4.6 as follows:

Not Applicable

Justification: ANSI K61.1 requires both above and below ground containers greater than 1200 gallons to be at least 5 ft. apart. However, OSHA 1910.111, *Storage and Handling of Anhydrous Ammonia*, only implements this requirement for underground containers; OSHA 1910.111(c)(5)(vii) states: "The distance between underground containers of over 2,000 gallons capacity shall be at least 5 feet." CGA G-2 (1995) addresses the safety requirements for the storage and handling of anhydrous ammonia and in Section 18.11.3 States: "Horizontal Clearance. The horizontal clearance between containers shall provide adequate access for emergencies, inspections, and maintenance." WTP's ammonia facility is aboveground, pier mounted, and monitored for ammonia releases and the installed platform provides access for personnel to facilitate operations, maintenance, inspections, and egress, therefore ANSI K61.1 Section 6.4.6 is not applicable.

Revise Section 6.4.7 as follows:

Not Applicable

Justification: Section specifies design requirements for the installation of underground storage systems. WTP does not plan to install underground storage system. Therefore, Section 6.4.7 of this standard will not be implemented for this project.

Revise Section 6.4.8 as follows:

Not Applicable

Justification: Section specifies design requirements for the installation of underground tanks. WTP does not plan to install underground tanks. Therefore, Section 6.4.8 of this standard will not be implemented for this project.

Page 20; Section 6.5 Reinstallation of containers

Revise Section 6.5 as follows:

Not Applicable

Justification: Section specifies requirements for reinstallation of containers. WTP does not plan to use previously used containers. Therefore, Section 6.5 of this standard will not be implemented for this project.

Pages 21-26; Section 7 Refrigerated storage

Revise Section 7 as follows:

Not Applicable

Justification: This section establishes design requirements for system using tanks for the storage of anhydrous ammonia under refrigerated conditions. WTP does not plan on a system using tanks for the storage of anhydrous ammonia under refrigerated conditions. Therefore, Section 7 of this standard will not be implemented for this project.

Pages 26-28; Section 8 Systems mounted on railcar structures (tank cars), other than DOT class 106A, for transportation of ammonia

Revise Section 8 as follows:

Not Applicable

Justification: This section establishes design requirements for tank cars for the rail transportation of ammonia. WTP does not plan to receive anhydrous ammonia by rail car. Therefore, Section 8 of this standard will not be implemented for this project.

Pages 31-32; Section 10 Systems using DOT portable tanks and cylinders

Revise Section 10 as follows:

Not Applicable

Justification: This section establishes requirements for cylinders (less than 1000 pounds), DOT portable tanks and DOT containers. WTP does not plan to receive anhydrous ammonia by container or cylinder. Therefore, Section 10 of this standard will not be implemented for this project.

Pages 32-34; Section 11 Systems mounted on farm wagons (implements of husbandry) for the transportation of ammonia

Revise Section 11 as follows:

Not Applicable

Justification: This section establishes requirements for equipment mounted on farm wagons for the transportation of ammonia. WTP does not plan to use farm wagons for the transportation of ammonia. Therefore, Section 11 of this standard will not be implemented for this project.

Pages 34-35; Section 12 **Systems mounted on farm wagons (implements of husbandry) for the application of ammonia**

Revise Section 12 as follows:

Not Applicable

Justification: This section establishes requirements for equipment mounted on farm wagons for the application of ammonia. WTP does not plan to use farm wagons for the application of ammonia. Therefore, Section 12 of this standard will not be implemented for this project.

Pages 35-37; Section 13 **References**

The references listed shall be constrained to the approved versions listed in the SRD or approved changes and equivalencies.

The following references shall be excluded:

ANSI/ASHRAE 15, American National Standard Safety Code for Mechanical Refrigeration

ANSI/IIAR 2, American National Standard for Equipment, Design and Installation of Ammonia Mechanical Refrigeration Systems

ANSI/ASME B31.5, American National Standard for Refrigeration Piping

ANSI/SAE J1513f, Refrigeration Tube Fittings

API Standard 620, Design and Construction of Large Welded Low-Pressure Storage Tanks

Justification: The above references are for the design of refrigerated storage systems. WTP does not plan to use a refrigerated anhydrous ammonia storage system. Therefore, these references will not be implemented for this project. The exception is ANSI/ASME B31.5 which provides a basis for utilizing certain materials in lower temperature applications considered compliant with the intent of ANSI K61.1 requirements for Piping, Tubing, and Fittings.

Limitations of Tailoring: The use of ASME B31.5 in WTP systems required to be compliant with ANSI K61.1 is limited to isolation valves on the ammonia storage vessels. ASTM A536 material is considered compliant with the intent of ANSI K61.1 paragraph 5.6.6, but its use is limited to ammonia storage vessel isolation valve bonnets.

The following references shall be excluded:

40 CFR Part 280, Technical standards and corrective action requirements for owners and operators of underground storage tanks (UST)

Justification: The above reference is for underground storage tanks. WTP does not plan to use underground storage tanks for anhydrous ammonia. Therefore, these references will not be implemented for this project.

The following references shall be excluded:

CGA G-7, Guide to the Preparation of Precautionary Labeling and Marking of Compressed Gas Containers

ANSI/CGA V-1, American National Standard Compressed Gas Association Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections

Justification: The above references are for the use of cylinders and small (less than 1 ton) containers. WTP does not plan to use cylinders or small containers for anhydrous ammonia storage. Therefore, these references will not be implemented for this project.

The following references shall be excluded:

ANSI/ASAE S276, Slow Moving Vehicle Identification Emblem

ANSI/ASAE S338.2, Safety Chain for Towed Equipment

Justification: The above references are for the use of ammonia systems mounted on farm equipment. WTP does not plan to use farm equipment for anhydrous ammonia storage. Therefore, these references will not be implemented for this project.

26.0 ASME B31.3-1996, Process Piping

Revision: 1996

Sponsoring Organization: ASME

WTP Specific Tailoring

The following tailoring of ASME B31.3, *Process Piping*, is required for use by the WTP contractor as an Implementing Standard for: (1) the fabrication and installation of those portions of the C5V ductwork that are being embedded in concrete, (2) the use of ASME B31.3-2010, Appendix P, Alternative Rules for Evaluating Stress Range for evaluating stress ranges due to pressure cycling and operational load cycling, (3) the use of ASME B16.9 welding tees in accordance with ASME B31.3-2002, (4) use of vacuum box leak testing, (5) the ASME B31.3-1998, paragraph 345.2.3(c), allowance for not leak testing closure welds outside of a closed cell (black cell) and/or hard-to-reach area, (6) the test pressure that is used for piping systems subjected and designed to HPAV events, and (7) design for HPAV Detonation/Deflagration loads and associated thermal gradients.

- The tailored sections of ASME B31.3 applicable to embedded ductwork will only be utilized to the extent that it will cover the fabrication, installation, and inspection (and associated testing) of Category D fluid service piping being used as C5 ductwork. Air testing requirements for this ductwork will be compliant with ASME AG-1. Below is a description of those portions of ASME B31.3 that apply to fabrication, installation, and inspection of Category D fluid service piping and the sections of the SRD that they will apply to.
- The tailored sections of ASME B31.3 applicable to welding tees will only be used for ASME B16.9 welding tees. As long as the stress intensification factors from ASME B31.3-2002 are used in the stress analysis for the welding tees, welding tees fabricated to either the 1996 or the 2002 edition of ASME B31.3 can be used. Below is a description of those portions of ASME B31.3, Appendix D, Table D300, that apply to welding tees and the section of the SRD to which they will apply.
- The tailored paragraphs of ASME B31.3 applicable to vacuum box leak testing, in lieu of hydrostatic or pneumatic leak testing, will only be used to leak test full penetration circumferential piping field butt welds inside a closed cell (black cell) and/or hard-to-reach area as defined in Appendix M, out to the first isolation component outside the closed cell (black cell) and/or hard-to-reach area. Further, if the 100 % volumetric inspection using ultrasonic examination per ASME B31.3 paragraph 344.6, is conducted for welds to be vacuum box tested, then the ultrasonic examination shall be conducted using a method that creates and maintains a reproducible computerized image(s) of the entire weld in the axial and radial direction.
- The tailored paragraphs of ASME B31.3 adopting the provisions of ASME B31.3 (c) - 1998 Addendum paragraph 345.2.3(c) are applicable to all ASME B31.3 piping in all facilities except for closure welds in closed cells (black cell) and/or hard-to-reach areas.

Piping providing a confinement function in accordance with SRD 4.4-3 and 5.1-2 will comply with the following sections of ASME B31.3-1996, *Process Piping*. These sections of ASME B31.3 are applicable for embedded ductwork.

Chapter 3, Materials

Chapter 5, Fabrication

Table 341.3.2, Visual acceptance criteria for Category D fluid service piping

Justification: Due to wall thickness requirements of duct embedded in concrete, piping materials are required. ASME B31.3 will apply to materials, fabrication, and inspection standards as appropriate. Testing requirements for nuclear air treatment systems will be consistent with ASME AG-1.

Piping providing a confinement function in accordance with SRD 4.4-2 will comply with the following sections of ASME B31.3-1996, *Process Piping* with the following modification.

ASME B31.3-2010 Appendix P: Alternative Rules for Evaluating Stress Range will be used to evaluate stress ranges due to pressure cycling and operational load cycling to address ASME B31.3-1996 Section 301.10: Cyclic Effects.

Justification: ASME B31.3-1996 Section 301.10 specifies that fatigue due to pressure cycling, thermal cycling, and other cyclic loadings shall be considered in the design of piping. No additional methodology is provided by code of record. Therefore, consideration of cyclic loading other than displacement controlled loading shall be achieved through the alternative rules provided in ASME B31.3-2010 Appendix P. This alternate rule does not apply to HPAV affected confinement piping systems as addressed separately in this Appendix to the SRD.

Piping providing a confinement function in accordance with SRD 4.2-2 will comply with ASME B31.3-1996, *Process Piping*, with the following modification:

In Table D300, the description of welding tee per ASME B16.9 shall be revised so it is consistent with that shown in Table D300 of ASME B31.3-2002:

		Stress Intensification Factor [Notes (2), (3)]			
Description	**Flexibility Factor k**	**Out-of-Plane, i_o**	**In-Plane i_i**	**Flexibility Characteristic, h**	**Sketch**
Welded tee per ASME B16.9 [Notes (2), (4), (6), (11), (13)]	1	$\frac{0.9}{h^{2/3}}$	$3/4\ i_o + 1/4$	$3.1\frac{T}{r_2}$	Same as ASME B31.3-1996

This means that for welding tees per ASME B16.9, note 11 in Table D300 is also changed to:

(11) If $r_x \geq 1/8D_b$ and $T_c \geq 1.5T$, a flexibility characteristic of $4.4\,T/r_2$ may be used.

Justification: The use of a lower flexibility characteristic for welding tees per ASME B.16.9 in accordance with ASME B31.3-2002 will increase both the out-of-plane and in-plane stress intensification factors. The increased stress intensification factors will reduce the allowable out-of-plane and in-plane

moments that can be applied to the welding tee and keep the calculated stress below the stresses allowable by ASME B31.3-1996.

Safety piping within the scope of SRD 4.2-2 shall comply with ASME B31.3-1996, Chapter V, Paragraph 345, using the following approach for vacuum box leak testing. Vacuum box leak testing, in lieu of hydrostatic or pneumatic leak testing, may be used to leak test full penetration circumferential piping, field butt welds inside a closed cell (black cell) and/or hard-to-reach area as defined in Appendix M, out to the first isolation component outside the closed cell (black cell) and/or hard-to-reach area, only under the following conditions:

Vacuum Box Leak Test Method - The vacuum box leak test shall be in accordance with a Bubble Test - Vacuum Box Technique method specified in ASME BPV Code, Section V, Article 10, Appendix II, subject to the requirements listed below:

(a) Sensitivity of the test shall be demonstrated to be not less than 1E-3 atm-ml/sec at 15 psig.

(b) The test pressure shall be a partial vacuum of at least 7 psi below atmosphere, applied to the outside of the weld.

(c) The required partial vacuum shall be maintained for at least 20 sec examination time.

In addition, the following limitations and restrictions shall apply to the application of vacuum box leak testing in lieu of a hydrostatic or a pneumatic leak test:

- Vacuum box leak testing will only be used to leak test circumferential piping field welds inside a closed cell (black cell) and/or hard-to-reach area (as defined in SRD Appendix M). This includes any welds in extensions of piping systems contained or originating in accessible areas between the closed cell (black cell) and/or hard-to-reach area boundary and the first isolation valve or device beyond the closed cell (black cell) and/or hard-to-reach area boundary;
- It shall only be used for piping field welds where required to avoid damage to components, ensure the safety to construction workers, perform leak tests of field welds where physical limitations prevent hydrostatic or pneumatic leak testing as prescribed in ASME B31.3-1996 paragraph 345.4 and paragraph 345.5 respectively;
- Pipe welds that are to be vacuum box leak tested will be assessed for suitability. The number of welds to be vacuum box leak tested shall be limited to a maximum of three welds between termination points (two termination or closure welds and one intermediate weld) on a given pipe system except where physical limitations prevent examination by hydrostatic or pneumatic leak testing. DOE will be informed of such exceptions, and may at its discretion and within 48 hours of being informed, respond to BNI on the suitability of the use of vacuum box leak testing for such instances. Termination points may be tanks, vessels, valves, etc. (Specifically excluded from the definition of termination points are junctions where the piping changes design class). This could be either the last two closure welds in a closed cell (black cell) and/or hard-to-reach area or the last closure weld in the closed cell (black cell) and/or hard-to-reach area and the last closure weld outside the closed cell (black cell) and/or hard-to-reach area. In addition, vacuum box leak testing would be permitted for the connection welds between construction modules if this is limited to one module-to-module weld per piping run within the cells. This is in addition to termination welds on the piping run. A module is defined as a pre-leak-tested subassembly containing multiple pipe spools;
- Vacuum box leak testing shall be limited to full penetration girth butt welds, on straight pipe or between straight pipe and pipe components of the same nominal pipe size and same wall thickness on

both sides of the weld at the weld location. The following configurations are candidates for vacuum box testing:

(a) Straight pipe to straight pipe connection butt welds

(b) Straight pipe to 90° elbow connection butt welds

(c) Straight pipe to 45° elbow connection butt welds

(d) Straight pipe to concentric reducer connection butt welds

(e) Straight pipe to eccentric reducer connection butt welds

(f) Straight pipe to butt welding tee connection butt welds

(g) Straight pipe to butt welding reduced outlet tee connection butt welds

(h) Straight pipe to valve nozzle connection butt welds

(i) Straight pipe to tank or vessel nozzle connection welds

(j) Straight pipe to safe-end of a weldolet connection butt welds - full penetration butt welded connection only

(k) Straight pipe to pipe cap connection butt welds

Prior to the application of vacuum box testing using any of the candidate configurations on piping butt welds at the WTP, the Contractor must successfully demonstrate to the DOE, for the candidate configuration, that (1) all portions of the weld to be inspected are visible and can be inspected in accordance with the ASME Boiler and Pressure and Vessel Code, Section V, Article 10, Appendix II - 1995; (2) the vacuum box can adequately maintain a partial vacuum of 7 psid; and (3) vacuum box leak testing can be accomplished in the time limits and other requirements established by this procedure. The DOE shall be advised at least 7 days in advance of any demonstration to qualify a new weld configuration so that they can witness the demonstration. The Contractor shall document any demonstration relied upon to justify the use of vacuum box leak testing on a new configuration. Further, vacuum box leak testing shall be conducted with a vacuum box that completely encapsulates the weld, at the test location;

- All welds shall be 100 % volumetrically inspected in accordance with ASME B31.3-1996, paragraphs 344.5 or 344.6. If the 100 % volumetric inspection is conducted using ultrasonic examination per ASME B31.3-1996 paragraph 344.6, then the ultrasonic examination shall be conducted using a method that creates and maintains a reproducible computerized image(s) of the entire weld in the axial and radial direction;
- It shall be limited to welds made using the Orbital welding machines. The only exception is that vacuum leak box testing may be used on manual welds if the 100 % volumetric inspection was conducted by radiography per ASME B31.3-1996 paragraph 344.5;
- The piping systems and or components on both sides of the weld to be vacuum box leak tested shall have been subjected to a hydrostatic leak test in accordance with ASME B31.3-1996 paragraph 345.4, a pneumatic test in accordance with ASME B31.3-1996 paragraph 345.5, a combination pneumatic-hydrostatic leak test in accordance with ASME B31.3-1996 paragraph 345.6, or in the case of components, leak tested in accordance with the Code or Standard applicable to the design of the component;
- At a minimum, a flexibility analysis in accordance with ASME B31.3-1996 paragraphs 319.4.2 (a) and (b) shall be required on any piping systems that contain welds that are to be vacuum leak box tested. In addition, a comprehensive flexibility analysis in accordance with ASME B31.3-1996 paragraphs 319.4.2 (c) and (d) shall be performed on any piping systems that contain welds that are to

be vacuum box leak tested when the piping systems have a design temperature greater than or equal to 150 °F;

- For manual welds, the requirements of ASME B31.3-1996 paragraph 344.7.1 (a) through (g) shall be invoked on any weld to be vacuum box leak tested with the exception that the requirement of subparagraph 344.7.1 (e) "... aided by liquid penetrant or magnetic particle examination when specified in the engineering design" shall not be required. For welds made using Orbital welding machines, the requirements of ASME B31.3-1996 paragraph 344.7.1 (a), (b), (c), (d), and (g) shall be invoked. The requirements of 344.7.1 (e) and (f) shall not be required. The implementation of these requirements shall be documented in the weld inspection report;
- Pipe welds and the associated line numbers that are to be vacuum leak box tested shall be identified in advance of the testing. This identification shall be documented in the controlled document Weld List, which must include this information prior to the initiation of any vacuum box leak testing associated with those welds and line numbers. It is understood that the controlled document Weld List may need to be revised and updated periodically through the construction phase of the WTP Project; and
- The following special requirements shall be placed on the training programs used to certify the technicians that will be conducting the vacuum box leak tests:
  1. The BNI Construction Manager shall pre-approve the technician qualifying examination(s) for vacuum box leak testing;
  2. The BNI Construction Manager shall pre-approve the qualifications of each Level III technician preparing or giving the examinations for vacuum box leak testing;
  3. DOE ORP at their discretion shall reserve the right to observe any and/or all practical leak test examinations and review of the results of any and/or all written vacuum box leak test examinations;
  4. The minimum topical content of each Level II examination shall be specified by BNI, and approved by DOE;
  5. The 80 % correct criteria for passing the examination shall apply to each part of the three part examinations that are to be given;
  6. BNI shall provide reasonable assurance that they will take adequate measures to assure the integrity of written examination is maintained; and
  7. There shall be several versions of each examination in use to assure Level II knowledge and ability concerning vacuum box leak testing is confirmed.

Justification: The requirement for the vacuum box leak test sensitivity is consistent with the ASME B31.3 requirement for a sensitive leak test as given in ASME B31.3-1996 paragraph 345.8 and for at least 7 psi vacuum and an examination time of at least 20 seconds. The limitations in using vacuum box leak testing better define when this method can be used. DOE ORP may further change the definition and application of these special vacuum box leak testing criteria based on the Contractor's experience with their use, or the Contractor's request for a change.

Piping system closure welds outside of a closed cell (black cell) and/or hard-to-reach area as defined in SRD Appendix M, shall comply with the requirements of ASME B31.3-1998, subparagraph 345.2.3(c). When ASME B31.3-1998, subparagraph 345.2.3(c) is invoked the following restrictions shall apply:

- It shall not be invoked on any closure welds on piping systems in a closed cell (black cell) and/or hard-to-reach area as defined in SRD Appendix M. This includes any welds in extensions of piping

systems contained or originating in a closed cell (black cell) and/or hard-to-reach area, between the closed cell (black cell) and/or hard-to-reach area boundary and the first isolation valve, or device beyond the closed cell (black cell) and/or hard-to-reach area boundary;

- It shall only be invoked on full penetration butt welds in straight pipe, full penetration butt welds at the safe-end of an equipment nozzle, or full penetration butt welds at the safe-end of branch connections. [The safe-end is defined as the piping to equipment nozzle connecting weld or the branch connection to branch piping connecting welds.];
- The requirements of ASME B31.3(c) - 1998, subparagraph 345.2.3 (c) shall be met;
- The piping systems and or components on both sides of the closure weld shall have been subjected to a hydrostatic leak test in accordance with ASME B31.3-1996 paragraph 345.4, a pneumatic leak test in accordance with ASME B31.3-1996 paragraph 345.5, a combination pneumatic-hydrostatic leak test in accordance with ASME B31.3-1996 paragraph 345.6, or in the case of components leak tested in accordance with the Code or Standard applicable to the design of the component;
- For manual welds, the requirements of ASME B31.3-1996 paragraph 344.7.1 (a) through (g) shall be invoked with the exception that the requirement of subparagraph 344.7.1 (e) "...aided by liquid penetrant or magnetic particle examination when specified in the engineering design" shall not be required. For welds made using the Orbital welding machines, the requirements of ASME B31.3 -1996 paragraph 344.7.1 (a), (b), (c), (d), and (g) shall be invoked. The implementation of these requirements shall be documented in the weld inspection report;
- Piping welds and the associated line numbers for which the closure weld classification is invoked shall be documented in a controlled document Weld List;
- Piping components may include mechanical elements other than piping; and
- In addition, BNI shall incorporate these requirements into the appropriate specification. DOE-ORP may further change the definition and application on the use of closure welds based on the Contractor's experience with their use or the Contractor's request for a change.

Justification: This change does not change the safety function of any pressure boundary components. The requirement to leak test pressure boundary field welds is primarily to ensure the reliability of the welds in addition to the reliability provided by the other required examinations. The exception allowed by ASME B31.3-1998, paragraph 345.2.3 that the final weld connecting piping systems or components which have been successfully tested in accordance with paragraph 345 need not be leak tested provided the weld is examined in-process in accordance with paragraph 344.7 (a), (b), (c), (d), and (g) and passes with 100 % radiographic examination in accordance with paragraph 344.5 or 100 % ultrasonic examination in accordance with paragraph 344.6 provides adequate assurance that the weld is reliable and leak tight. The change continues to provide adequate safety since it requires that all piping closure welds that are not leak tested are in-process examined and 100 % volumetrically examined which exceeds the requirements of ASME B31.3-1996 for closure welds that are leak tested. The inability to hydrostatically or pneumatically leak test these closure welds does not affect the soundness of the welds.

Exception to B31.3 Paragraph 302.2.4

Piping subjected to HPAV events, as defined in Appendix A, Section 5.4, and designed to withstand those events without controls will be leak tested at a pressure equal to the system design pressure (from the Mechanical line list) multiplied by the applicable factors in Section 345 of ASME B31.3-1996, *Process*

Piping. The HPAV pressure will be permitted to exceed the test pressure, which is an exception to Paragraph 302.2.4.

Justification: ASME B31.3 does not address highly impulsive pressure loading, and does permit the designer to perform detailed analysis for unusual situations, as indicated in Paragraph 304.7.2 for Unlisted Components. The design rules developed in Report 24590-WTP-RPT-ENG-07-011, Revision 2, ensure that the piping system will maintain pressure boundary under all conditions.

Design for Hydrogen Detonation/Deflagration Loads and Thermal Gradients

This section provides design criteria to determine the acceptable responses of piping systems and components to occasional loads that may result from HPAV events. Piping routes that fail to meet these criteria require preventive controls. The development of such criteria is permitted by B31.3 and is, therefore, not a deviation from it.

A best-estimate design tool may be used to determine the number of cycles for defined classes of HPAV events that differ in applicable structural design considerations for their accommodation subject to the following constraints to ensure consistency with safety analysis expectations:

1. The route specific factors that affect the potential for significant quantities of combustible gases to accumulate must be considered, including the maximum expected waste characteristics (i.e., combustible gas generation rate, temperature, viscosity), the proposed configuration of the route, and the related human and equipment failure rates.
2. An ignition probability of one is to be assumed at each maximum bubble size unless a technical basis for a lower probability is submitted to DOE-ORP and receives their concurrence.
3. The design tool shall not be used to exclude limiting events such as PRC-DDT that can occur for credible gas configuration conditions.
4. A defined class of events may be designated as structurally insignificant provided the included events are shown not to affect compliance with these Appendix C, B31.3 tailoring provisions.
5. Documentation of the model must be provided including the process for its application, the defined event classes, the parameters chosen, and the results.

For HPAV events, analysis will use 100/sec strain-rate dependent stress-strain curves for austenitic stainless steels (SS 304, 304L, 316 and 316L), which are used in the construction of WTP piping systems. Strain rate dependent properties will be developed based on a literature survey of academic, National Laboratory and industry information, covering the range of experimental test data to which the material in question will be subjected in service. Specifically, the experimental data requirements shall provide:

(a) A lower-bound estimate for strength over the strain rate and temperature regime of interest,

(b) Variation of yield strength with strain-rate and temperature,

(c) Variation of the rate of strain-hardening with strain-rate,

(d) Determination of a loading path-dependence to both the quasi-static (QS) and rate-dependent yield behavior,

(e) A loading path-dependence to both the quasi-static (QS) and rate-dependent strain-hardening behavior, and

(f) Development of an equation (or mathematical model) that describes the strength properties over the regime of interest.

(g) Scaled to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 2, static, room temperature true stress-true strain curve.

Events Affecting Piping Located in Black Cells or Designated as Hard-To-Reach

Deflagrations events must meet the criteria of ASME B31.3-1996, *Process Piping*, and B31.3 Code Case 178, with appropriate consideration of deflagration pressure, sustained loads, and thermal gradients.

In evaluating Code Pressure Boundary for detonation events (including deflagration to detonation [DDT] transitions and reflected DDTs [PRC-DDT]), the straight pipe equivalent through-wall average strain will be limited to 0.2 % plastic strain using the 100/sec strain-rate dependent stress-strain curves, finite element time-history analysis, and end-of-life wall thickness.

For bends fabricated from straight pipe, the equivalent through-wall average strain will be limited to 0.2 % plastic strain using the 100/sec strain-rate dependent stress-strain curves, finite element time-history analysis, and end-of-life wall thickness.

Fittings (tees, elbows, reducers) manufactured in accordance with B31.3 Paragraph 303 and the standards listed in B31.3 Table 326.1 are considered to be as strong as the matching pipe, due to the burst test requirements of the standards. BNI will verify that burst test methods (in lieu of calculation methods) have been used to validate representative fitting designs.

Fatigue damage from high frequency oscillations, bar waves, thermal gradients, pressure changes, and traveling detonation waves must be evaluated.

B31.3 302.3.5 limits the sum of longitudinal stresses due to pressure, weight, and other sustained loads to S_h, the basic Code allowable at maximum temperature. Combining only longitudinal stresses, as is done in B31.3 paragraph 302.3.6, does not consider the possible combination of hoop and longitudinal (axial) effects. For highly dynamic pressures during a traveling wave detonation event, the axial and hoop effects due to pressure are not necessarily both tensile, so a departure from the normal B31.3 methods (sum of longitudinal stresses) must be made to allow for the possible combination of hoop and axial effects. Therefore, for traveling wave detonation events, the combination of hoop and axial effects must be considered without exceeding the 100/sec strain-rate dependent yield; the dynamic interaction ratio added to the dead weight interaction ratio shall not exceed 1. Since DDT and PRC-DDT events are point events, the requirement to combine hoop and axial effects does not apply.

Events Affecting Piping Not Located in Black Cells or Designated as Hard-To-Reach

Except as noted below, all HPAV requirements in the BC/HTR apply. The criteria below are limited to affected piping systems and components located in the HLW Process Cells, or in the Pretreatment facility Hot Cell and C3 area bulges that serve as extensions of the Hot Cell.

For HPAV events that are anticipated to result in a PRC-DDT, detonation, or DDT, the maximum pressure that produces a straight pipe (or 3D bend, whichever is limiting) equivalent through-wall average strain of 0.2 % plastic strain, as determined above for the BC/HTR, will be permitted to be 1.5 times higher. This results in a plastic through-wall average strain estimated to be less than 2.5 %.

Other Components

Stresses in the nozzle/vessel intersection or in the dipped line due to the traveling detonation wave loading will be combined with stresses due to normal loads (PJM operation, if applicable, thermal expansion, internal pressure, weight) and the primary results limited to 1.2 times the normal condition allowable stress for that type of stress, as permitted by the ASME Boiler and Pressure Vessel Code, Sections VIII-1 and VIII-2, for occasional loads.

Stresses in pipe supports inside BC/HTR areas under combined weight, thermal expansion, and detonation loading will be limited to B31.3 allowable stress (if a catalog support) or the AISC allowable stress (if a structural shape), for occasional loads.

Stresses in pipe supports outside BC/HTR areas under combined weight, thermal expansion, and detonation loading will be limited to 1.6 times the B31.3 or AISC normal condition allowable stress. The basis for the 1.6 is AISC N690, Table Q1.5.7.1 for extreme and higher loading.

In-line instrumentation, such as pressure transducers, will be shown to be acceptable up to DDT loading by limiting the maximum pressure to the maximum rated pressure of the instrumentation pressure boundary. Since these items are replaceable, i.e., there are none in Black Cells, their possible failure to function after a PRC-DDT is acceptable.

Components such as jumper connectors, valves, jet pump pairs, etc., whose function cannot be demonstrated by analysis alone may be qualified by a combination of analysis and test as follows:

1. Analyses per the criteria above as applicable for the component boundary.
2. Demonstrate other significant design aspects such as leak tightness of jumper connectors or valve operability, closure function and stem leakage by performing a bounding impulsive load test. Provide test acceptance criteria similar to those that would be used for the same functions in a seismic test.

Justification: ASME B31.3 does not address detonation pressure loading, but does permit the designer to perform detailed analysis for unusual situations, as indicated in Paragraphs 300(c)(3) and 304.7.2. The purpose of the criteria described above is to implement that provision.

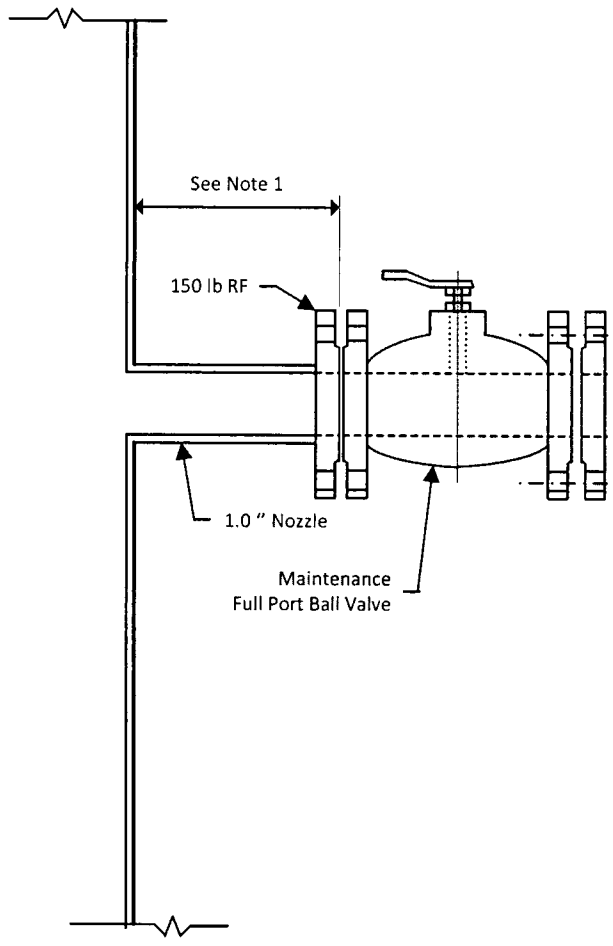
ATTACHMENT 3

Deleted

ATTACHMENT 4

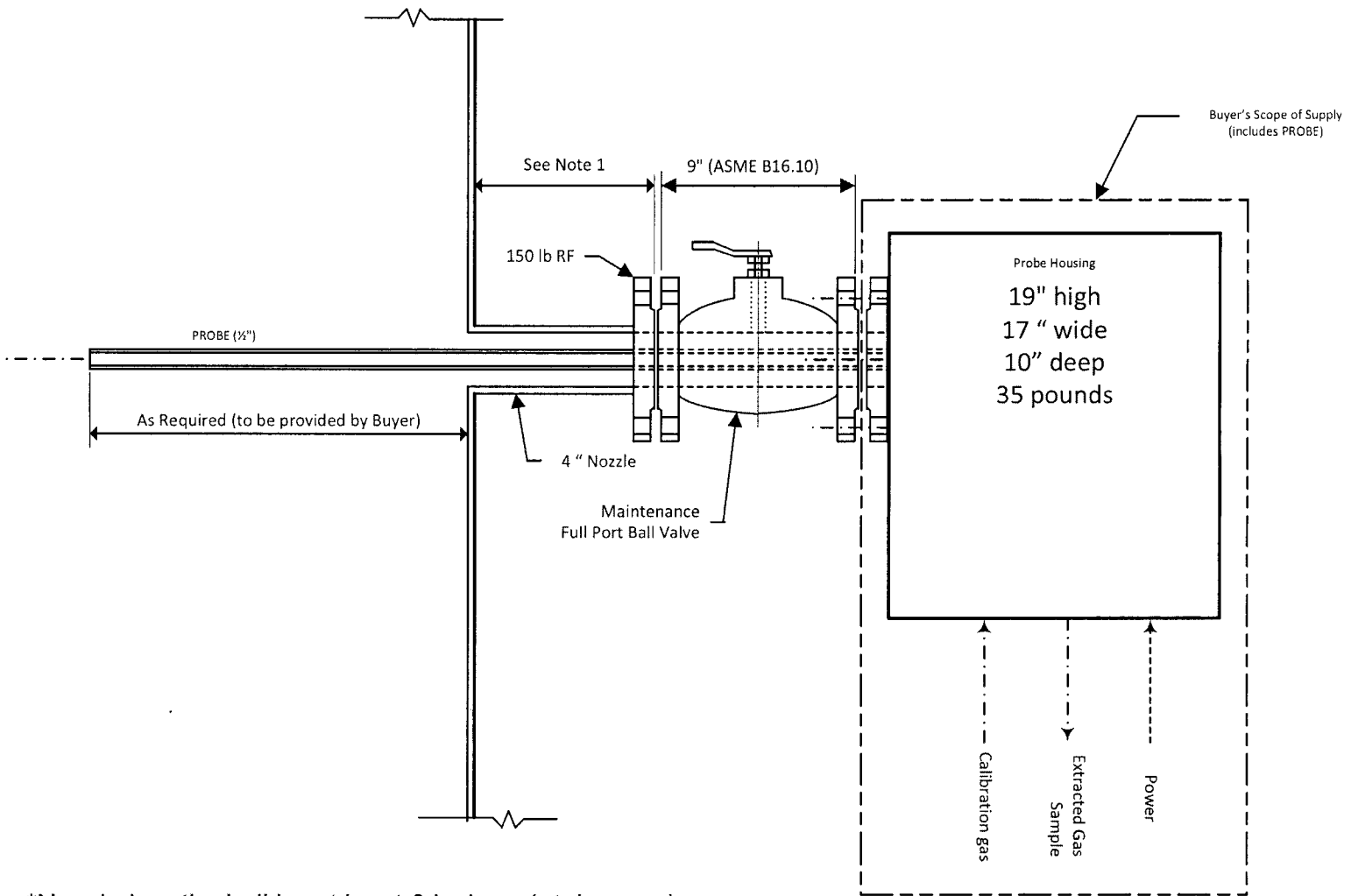
LAW SKID INTERFACE CONNECTIONS

SERVICE	NOZZLE	SIZE	INTERFACE
LVP-SKID-00002			
PROCESS GAS IN	N01	18"	FLG WN, A182-F316/316L, CL150, RF
PROCESS GAS OUT	N02	18"	FLG WN, A182-F316/316L, CL150, RF
AMMONIA/AIR IN	N03	8"	FLG WN, A182-F316/316L, CL300, RF
LVP-SKID-00003			
AMMONIA/AIR OUT	N04	8"	FLG WN, A182-F316/316L, CL 300, RF
AMMONIA GAS IN	N05	2"	FLG SW, A350LF2, CL300, XS, RF
C3 DUCT AIR IN	N01	8"	FLG WN, A182-F316/316L, CL150, SCH 10, RF
C3 DUCT AIR IN	N02	8"	FLG WN, A182-F316/316L, CL150, SCH 10, RF



Note 1: *Nozzle length shall be at least 6 inches (- tolerance).
*There shall be at least 3 inches (- tolerance) of clearance, for tightening bolts, between the surface of the insulation jacketing and the underside of the flange.

Scale: None
Connection for Non-Routine Sample Extraction



Note 1: *Nozzle length shall be at least 6 inches (- tolerance).
*There shall be at least 3 inches (- tolerance) of clearance, for tightening bolts, between the surface of the insulation jacketing and the underside of the flange.

Scale: None
Connection for Sample Extraction-Permanent Typical
Secondary Offgas Flange Connection for Gas Monitor Probe with Ball Valve for Maintenance
Gas Extraction Connection

Attachment 7

Certificate of Analysis for BASF Catalysts, LLC (VOCat 300S)

This Certificate of Analysis (COA) for VOCat 300S is representative of VOCat 300S catalyst used by Catholic Vitreous State Laboratory (VSL). Seller's use of the COA is described in Section 10.2.5.3.

BASF
ENVIRONMENTAL CATALYST GROUP
9800 KELLNER ROAD
HUNTSVILLE, ALABAMA 35824
Main Phone # (256) 772-9373

CERTIFICATE OF ANALYSIS

LOT CONTROL NO: 3642401500 HSV PART NO: 166204-001 Customer Part Numt N/A

PART SIZE: 5.91 X 5.91 X 3 CPSI: A200 Customer P/O Numb **CUA-0000016866**

THIS IS TO CERTIFY THAT CATALYSTS DELIVERED MEET REQUIREMENTS OF:

CATALYST DRAWING: **PS - 1118** REV. 3 SPECIFICATION: **PS - 057** REV. 8

FINAL INSPECTION PROC. **SOP - 0231** REV. 8

PRECIOUS METAL CONCENTRATION (SAMPLE OF ALL) IN g/ft3

TOTAL PM CONCENTRATION	SPEC	SAMPLE
MAX. AVERAGE	NR	
MIN. AVERAGE	32.51	35.53
MIN AVERAGE TPM	NR	NR
MIN INDIVIDUAL TPM	28.31	33.88

DRY GAIN	SPEC	SAMPLE
MAX. AVERAGE	2.15	
MIN. AVERAGE	1.29	1.72

DIMENSIONAL (AS PER AQL) IN INCHES

WASHCOAT ADHESION (% LOSS)

SAMPLE OF 1	SPEC	SAMPLE
MAX. INDIVIDUAL	2.0	1.0

BET SURFACE AREA IN mm2/cc

SAMPLE OF 1	SPEC	SAMPLE
MIN. INDIVIDUAL	4.0	11.9

MIN. FLOW (AFCM)

	SPEC	SAMPLE
MIN. INDIVIDUAL	TBD	381

CATALYTIC ACTIVITY IN DEG F

SAMPLE OF 1	SPEC	SAMPLE
MAX HEXANE T 20	289	200.0
MAX HEXANE t 50	387	347.0
MIN HEXANE CONV. @ 450c	92	98.0

VISUAL (AT 1.5 AQL): ALL REQUIREMENTS FOR FLATNESS, CHIPS, WORKMANSHIP, GOUGES, CRACKS, WEB DEFECTS, AND PASSAGE DEFECTS HAVE BEEN MET OR EXCEEDED AS DEFINED ON THE APPROPRIATE DRAWING.

COMMENTS:

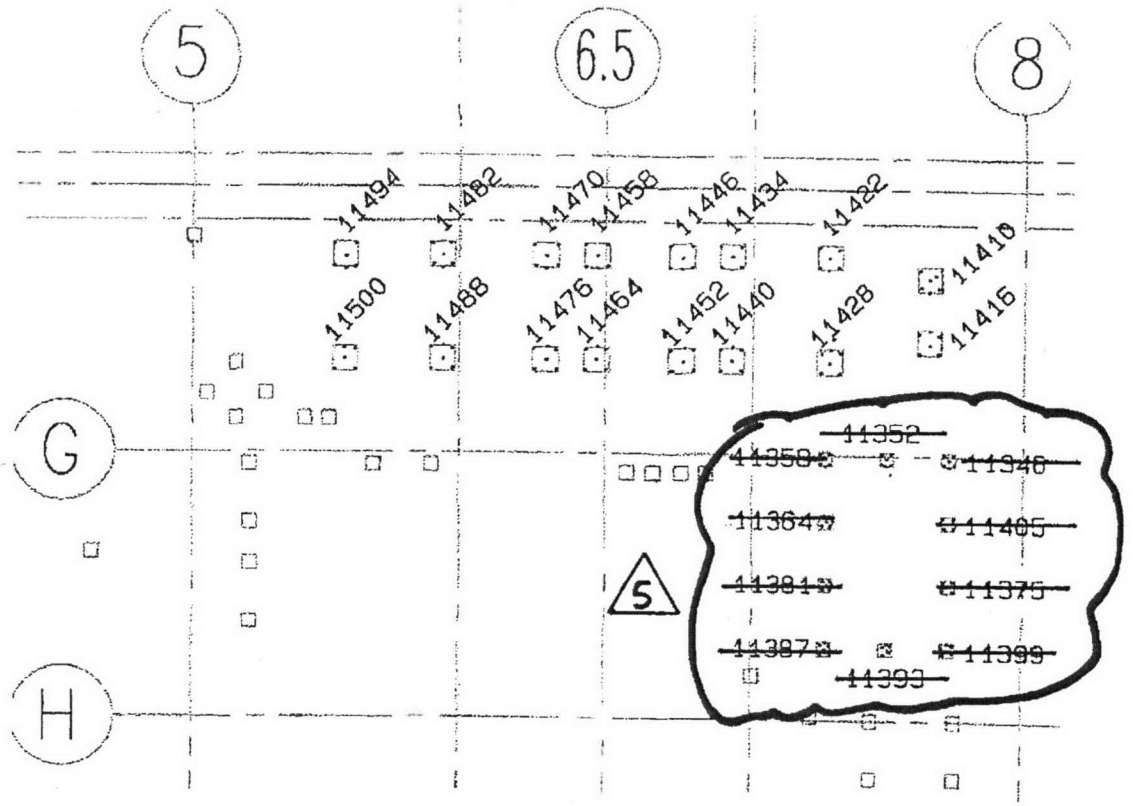
Jason Weber 6-1-09

PROCESS QUALITY REPRESENTATIVE DATE

5 Attachment 8

LAW TCO ~~& Ammonia/Air Dilution Skid~~ Embed As-Built Elevations

[Reference Drawing 24590-LAW-DB-S13T-00135]



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~~11387~~	~~47.995~~
~~11393~~	~~47.978~~
~~11399~~	~~47.986~~
11410	47.963
11416	47.973
11422	47.963
11428	47.973

5

Embed #	Elevation
11434	47.978
11440	47.993
11446	47.976
11452	47.992
11458	47.969
11464	47.967
11470	47.964
11476	47.972
11482	47.969
11488	47.976
11494	47.976
11500	47.967

ATTACHMENT 9

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ATTACHMENT 10

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ATTACHMENT 11

SAMPLE Certificate of Conformance

I (Signer's Name) , (Signer's Title) of (SELLER), being duly authorized by (SELLER) to make this certification, do hereby certify that:

1) The (Equipment descriptive name - Example: Pressure Transmitter), Model No.(s) (or Equivalent Identification), supplied to the WTP Project for application as Nuclear Safety item(s) under (MR /P.O. No., or equivalent Buyer's purchase document no.) is (are) environmentally and seismically qualified in accordance with the requirements in the standards, specifications, data sheets and technical notes in said purchase documents and will meet the acceptance criteria stated for its safety function.

2) The said environmental and seismic qualification are based on the tests, analyses and results documented in: (List of documents establishing Environmental and Seismic Qualification to WTP requirements)

3) The particular items (Equipment descriptive name(s), Model (Model designation(s) and List of serial numbers or other identification of the particular items supplied for Nuclear Safety application to the WTP project) supplied for Nuclear Safety application at the WTP Project are identical to, or have been shown to be sufficiently similar to, the test sample(s) subjected to qualification testing/analyses documented in the qualification documents listed above, such that the data and results in the said documents are specifically applicable to the particular items supplied to the WTP project. (If necessary) Sufficient similarity between the test sample(s) and the safety related items supplied to WTP is documented in (Document title).

4) All modifications to the test sample and manufacturing methods which were necessary to establish qualification have been effected in the particular items supplied to the WTP Project.

5) All maintenance, surveillance requirements necessary to maintain the qualified status of the equipment in the installed configuration and service conditions at the WTP Project are stated in (Document Title).

6) All replacements of parts necessary to maintain the qualified status of the equipment in the installed configuration and service conditions at the WTP Project are stated in (Document Title).

Seller (Company name) _____

Signature of Authorized Representative _____

_____
Date Signed

Name of Authorized Representative _____

Title of Authorized Representative _____

ATTACHMENT 12

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ATTACHMENT 13

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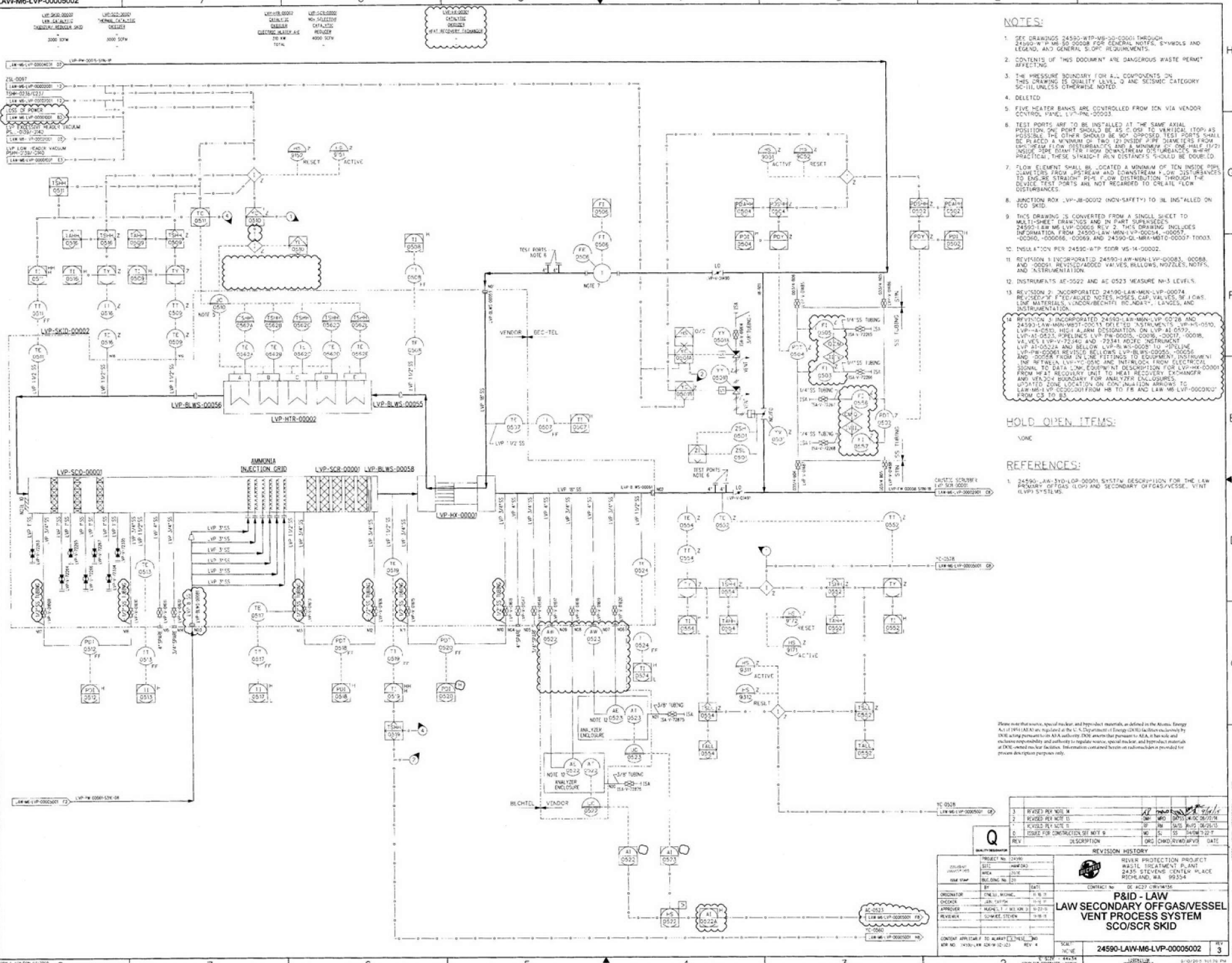


NOTES:

1. SEE DRAWINGS 24590-WTP-M6-30-00001 THROUGH 24590-WTP-M6-30-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL Q AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED.
4. DELETED.
5. FIVE HEATER BANKS ARE CONTROLLED FROM ICN VIA VENDOR CONTROL PANEL LVP-PNL-00003.
6. TEST PORTS ARE TO BE INSTALLED AT THE SAME AXIAL POSITION. ONE PORT SHOULD BE AS CLOSE TO VERTICAL (TOP) AS POSSIBLE. THE OTHER SHOULD BE 90° OPPOSED. TEST PORTS SHALL BE PLACED A MINIMUM OF TWO (2) INSIDE PIPE DIAMETERS FROM UPSTREAM FLOW DISTURBANCES AND A MINIMUM OF ONE-HALF (1/2) INSIDE PIPE DIAMETER FROM DOWNSTREAM DISTURBANCES. WHERE PRACTICAL, THESE STRAIGHT RUN DISTANCES SHOULD BE DOUBLED.
7. FLOW ELEMENT SHALL BE LOCATED A MINIMUM OF TEN INSIDE PIPE DIAMETERS FROM UPSTREAM AND DOWNSTREAM FLOW DISTURBANCES TO ENSURE STRAIGHT PIPE FLOW DISTRIBUTION THROUGH THE DEVICE. TEST PORTS ARE NOT REGARDED TO CREATE FLOW DISTURBANCES.
8. JUNCTION BOX LVP-JB-00012 (NON-SAFETY) TO BE INSTALLED ON SCO SKID.
9. THIS DRAWING IS CONVERTED FROM A SINGLE SHEET TO MULTI-SHEET DRAWINGS AND IN PART SUPERSEDES 24590-LAW-M6-LVP-00008 REV 2. THIS DRAWING INCLUDES INFORMATION FROM 24590-LAW-M6N-LVP-00054, -00057, -00060, -00066, -00069, AND 24590-QL-MRA-MBT0-00007-T0003.
10. INSULATION PER 24590-WTP-SDDR-MS-14-00002.
11. REVISION 1: INCORPORATED 24590-LAW-M6N-LVP-00083, 00088, AND -00091. REVISED/ADDED VALVES, BELLOWS, NOZZLES, NOTES, AND INSTRUMENTATION.
12. INSTRUMENTS AE-0522 AND AE 0523 MEASURE NH-3 LEVELS.
13. REVISION 2: INCORPORATED 24590-LAW-M6N-LVP-00074. REVISED/ADDED NOTES, HOSES, CAP, VALVES, INFLOWS, LINE MATERIALS, VENDOR/BECHTEL BOUNDARY, TAGNOS, AND INSTRUMENTATION.
14. REVISION 3 INCORPORATED 24590-LAW-M6N-LVP-00128 AND 24590-LAW-M6N-MBOT-00011 DELETED "INSTRUMENTS LVP-HS-0510, LVP-HA-0510, HIGH ALARM DESIGNATION ON LVP-AE-0522, LVP-AE-0523, PIPELINES LVP-PW-00015, -00016, -00017, -00018, VALVES LVP-V-72340 AND -72341 AO/FC INSTRUMENT LVP-AT-0522A AND BELLOW LVP-BLWS-00058 TO "PIPELINE LVP-PW-00061 REVISED LINES, LVP-BLWS-00055, -00056 AND -00058 FROM IN-LINE FITTINGS TO EQUIPMENT. INSTRUMENT LNF RETABLE LVH-YC-0516 AND INTERLOCK FROM ELECTRICAL SIGNAL TO DATA LINK EQUIPMENT DESCRIPTION FOR LVP-HX-00001 FROM HEAT RECOVERY UNIT TO HEAT RECOVERY EXCHANGER AND VFA-304 BOUNDARY FOR ANALYZER ENCLOSURES. UPDATED ZONE LOCATION ON CONTINUATION ARROWS TO LAW-M6-LVP-00060UT FROM H8 TO F8 AND LAW M6 LVP-00061UT FROM C8 TO B8.

HOLD OPEN ITEMS:

NONE

REFERENCES:

1. 24590-LAW-3YD-LOP-00001, SYSTEM DESCRIPTION FOR THE LAW PRIMARY OFFGAS (LOP) AND SECONDARY OFFGAS/VESSEL VENT (LVP) SYSTEMS.

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

REV	DESCRIPTION	ORG	CHKD	RVWD	APVD	DATE
3	REVISED PER NOTE 14	DMP	MRD	BATES		04/DEC/13
2	REVISED PER NOTE 13	DMP	MRD	BATES	JWW	08/DEC/13
1	REVISED PER NOTE 11	SP	RM	SMS	JWW	08/26/13
0	ISSUE FOR CONSTRUCTION, SEE NOTE 9	MD	JS	SS	JWW	13-DEC-12

REVISION HISTORY

PROJECT No.	24590
SITE	HANFORD
AREA	200E
BLDG. No.	291
BY	DATE
ORIGINATOR	CINCILLI, MICHAEL P. 9-18-11
CHECKER	LIEN, TAYLOR 11-9-11
APPROVER	HUGHES, T. / MD, KIM J. 10-22-13
REVIEWER	SCHMEE, STEVEN 11-18-11

CONTENT APPLICABLE TO ASME? YES NO
ADR NO. 24590-LAW-ADR-W-12-003 REV. 4

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No. DE-AC27-08RV14836

P&ID - LAW
LAW SECONDARY OFFGAS/VESSEL VENT PROCESS SYSTEM SCO/SCR SKID

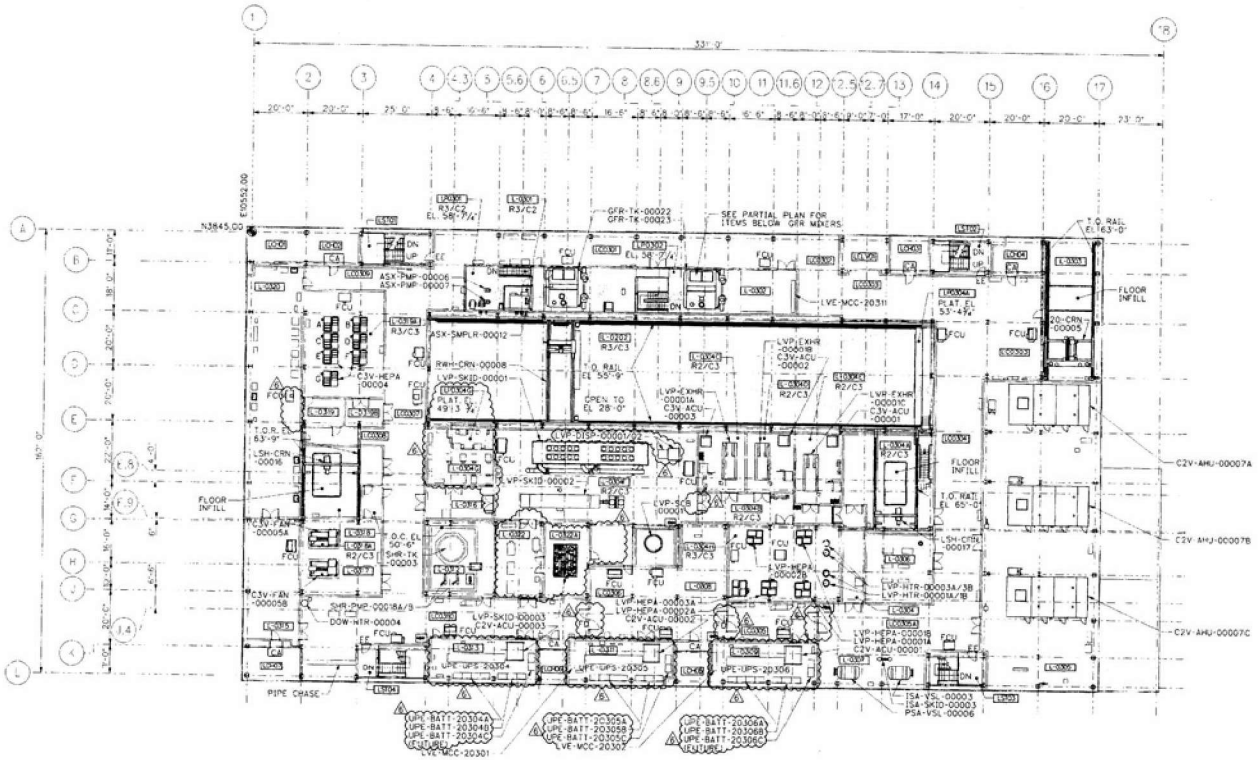
SCALE: NONE

24590-LAW-M6-LVP-00005002

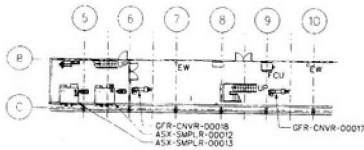
REV 3

SIZE 44x34

COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED



PLAN AT EL 48'-0"



PARTIAL PLAN AT EL 48'-0"

KEY PLAN

NOTES:

1. FOR GENERAL NOTES, SEE 24590-LAW-P1-P01T-00001.
2. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
3. SEE NOTE 3 ON REV 4 OF THIS DRAWING FOR REV 4 HISTORY.
4. THE RADIATION/CONTAMINATION CLASSIFICATIONS DEPICTED ON THE DRAWING ARE FOR DESIGN PURPOSES ONLY AND DO NOT NECESSARILY INDICATE THE ACTUAL RADIOLOGICAL CLASSIFICATION DURING RADIOACTIVE OPERATIONS.
5. ROOMS ARE OFFICIALLY IDENTIFIED BY ROOM NUMBERS ONLY. ROOM NUMBERS ARE ESTABLISHED AND CONTROLLED ON GENERAL ARRANGEMENT DRAWINGS ONLY. ROOM NUMBERS ARE NEEDED TO IDENTIFY ROOMS ON ENGINEERING DISCIPLINE DOCUMENTS, WHILE ROOM NUMBERS ARE CONTROLLED, THE MOST COMMON NAME OF ROOMS ASSOCIATED WITH EACH ROOM NUMBER ARE SHOWN FOR REFERENCE ONLY ON ARCHITECTURAL FLOOR PLANS.
6. SEE NOTE 6 ON REV 5 OF THIS DRAWING FOR REV 5 HISTORY.
7. REVISED TO INCORPORATE THE FOLLOWING:

   24590-LAW-PIN-P01T-00070: REVISED FCU IN L-0320.

   24590-LAW-PIN-P01T-00073: REVISED C2V-ACU-00001/02/03.

   24590-LAW-PIN-P01T-00075: REMOVED HOLD 19 FROM LVP-EXHR-00001A/B/C.

   24590-LAW-PIN-P01T-00076: PARTITIONED L-0322 TO ADD L-0322A.

   24590-LAW-PIN-P01T-00077: ADDED LVP-DISP-00001/02.

   24590-LAW-PIN-P01T-00079: REVISED UPE EQUIPMENT.

   24590-LAW-PIN-P01T-00080: DELETED SECTION CUT SYMBOLOGY.

   24590-LAW-PIN-P01T-00083: ADDED LPO304G, DELETED DOOR ON EAST WALL OF L-0304G. REVISED DOOR ON EAST WALL OF L-0316.

   24590-LAW-AIN-A1OT-00079: REVISED DOORS AND WALL IN LC0305 AND LC0306.

   24590-LAW-AIN-A1OT-00089: REVERSED DOOR SWING DIRECTION ON WEST WALL OF L-0304B.

   REVERSED DOOR SWING DIRECTION ON NORTH WALL OF L-0322.

   DELETED HOLD 19. HOLDS ARE NO LONGER TRACKED ON GA DRAWINGS.

   REVISED TITLE BLOCK.

   ADDED NOTE 7. REVISED NOTES 3 AND 6.

DESIGN CHANGES INCORPORATED BY REFERENCE	
DOCUMENT NO	DOCUMENT NO
24590-WTP-ECS-ST-02D	

LEGEND:

CA	CONTROLLED ACCESS
EE	EMERGENCY EXIT
FCU	FAN COIL UNIT
FD	FIRE DOOR
L-XXXX	ROOM, CELL, (VAULT) OR TUNNEL
LCXXXX	
LMXXXX	MEZZANINE
LPXXXX	ROOM PLATFORM
LPCXXXX	CORRIDOR PLATFORM
LCHXX	CHASE
LELVXX	ELEVATOR
LSTXX	STAIR
	EQUIPMENT LAYDOWN AREA
	CONCRETE
	CHECKERED PLATE
	GRATING
	EMERGENCY EYEWASH
	LADDER
	EMERGENCY SHOWER/EYEWASH
	FLOOR PENETRATION

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REV	DESCRIPTION	ORG	CHKD	RVWD	APVD	DATE
6	REVISED TO INCORPORATE CHANGES IN NOTE 7	JTC	DSS			6/9/15
5	REVISED TO INCORPORATE CHANGES IN NOTE 6	JTC	ZB	SM		10/14/13
4	REVISED TO INCORPORATE CHANGES IN NOTE 3	CMS	RLS	JKL	TAP	11/16/11
0	ISSUED FOR DESIGN SUPERSEDES DWG-W375V-P1-00046, REV 0			JK	CMS	PR 5/25/05

REVISION HISTORY

	BY	DATE
ORIGINATOR	TIMOTHY E. HEMMENS	10/25/05
CHECKER	CRAIG M. SALERNO	10/25/05
APPROVER	C. J. KOGLER	10/25/05
RELEASER	PHIL M. BIDWELL	10/25/05

CONCEPT APPLICABLE TO ALARA? [X] YES [ ] NO

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No. DE-AC27-09RV14136

LAW VITRIFICATION BUILDING GENERAL ARRANGEMENT PLAN AT EL. 48'-0"

PROJECT No.	24590
SITE	HANFORD
AREA	200E
BUILDING No.	591

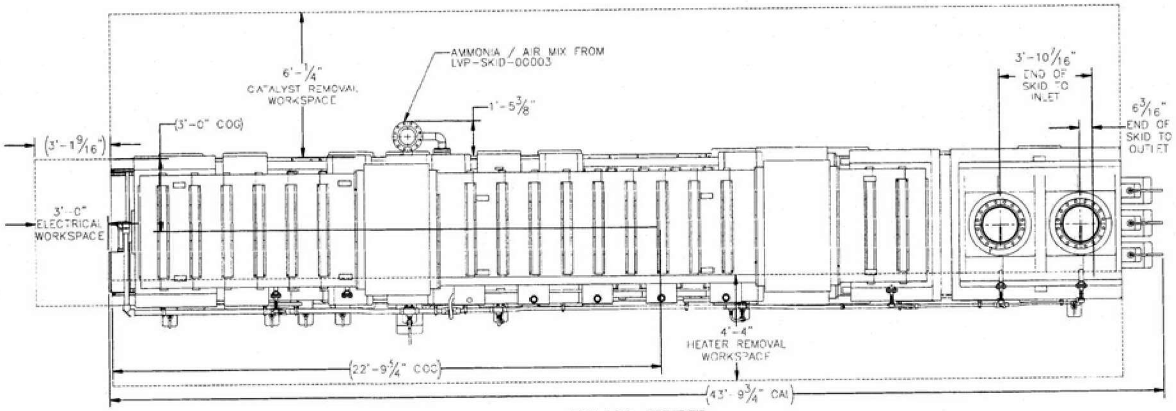
SCALE 1/8"=1'-0" (22x34) 1/16"=1'-0" (11x17)

24590-LAW-P1-P01T-00005

REV 6

COMPUTER GENERATED. MANUAL DESIGN CHANGES NOT PERMITTED.

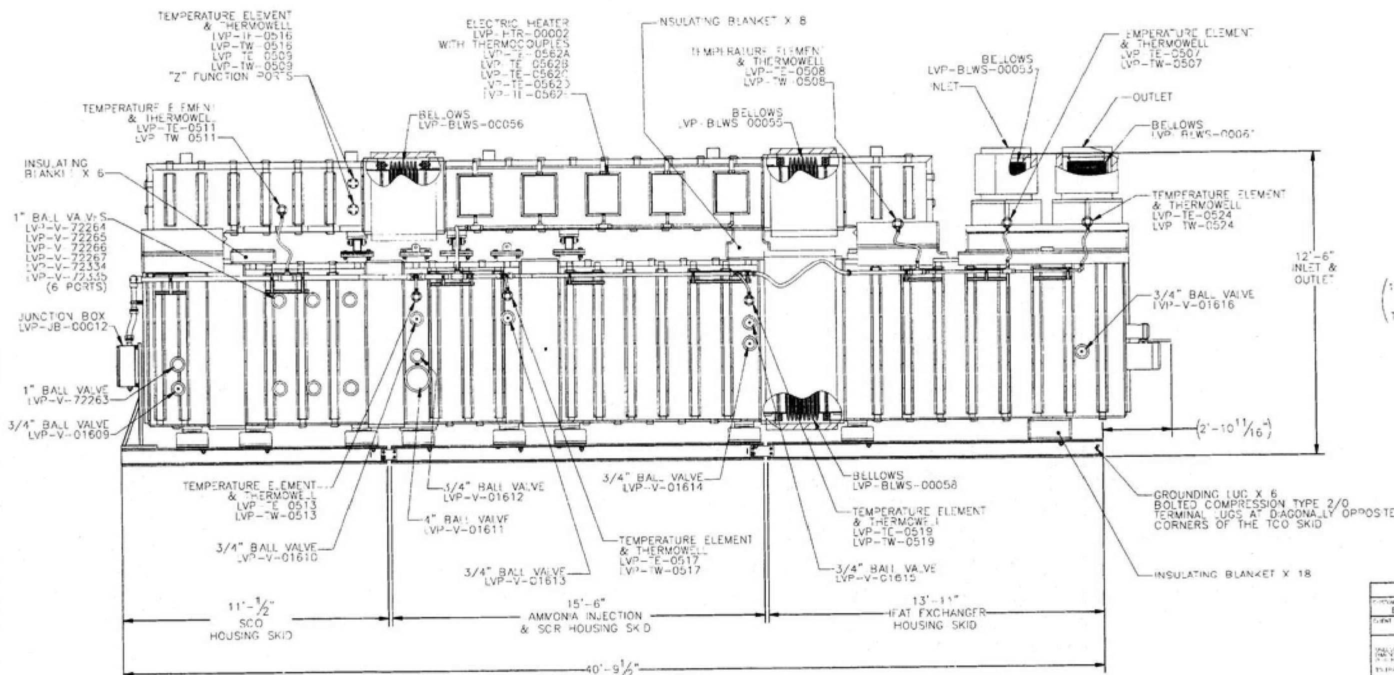
REV.	DESCRIPTION	REV BY	CHKD BY	APPROVED BY	DATE
A	[illegible]	PV	RP	DWP	[illegible]
B	[illegible]	PV	RP	MP	[illegible]
C	[illegible]	NS	RP	MP	[illegible]
D	CHANGED ALL DIMENSIONS TO COLUMN LINES TO BE REFERENCE ON SHEETS 3 & 4	NS	RP	[illegible]	[illegible]



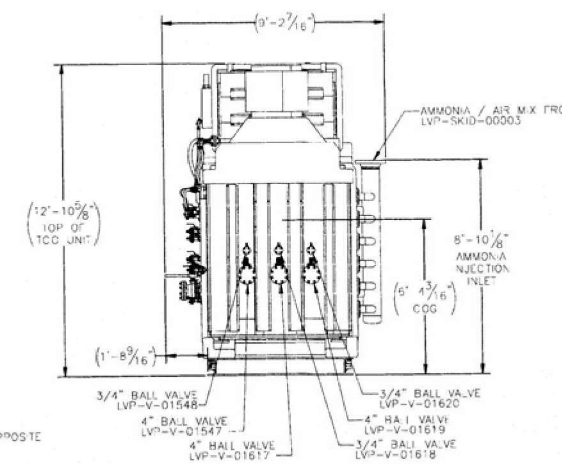
PLAN VIEW

N

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.



ELEVATION VIEW



END VIEW

24590-CD-POC-MBTO-00007-01-00353 00E

NOTES:
1. REFERENCE DRAWING 913040-060-001 FOR P&ID
2. SEE SHT 4 FOR ADDITIONAL NOTES
3. SEE 913040-DAT-015 FOR BALL VALVE INSULATION BLANKET TAG NUMBERS

APPROXIMATE WEIGHT: 122665 LBS

CUSTOMER: BECHTEL NATIONAL INC.
CLIENT: DOE-ORP
CONTRACT NO: 24590-CD-POC-MB10-00007
COMPONENT NO: 24590-LAW-MX-LVP-SKID-00002
LOCATION: WASHINGTON STATE, 200 EAST AREA OF THE HANFORD SITE
EQUIPMENT SERVICE: LVP OFFGAS SYSTEM

NIONEX
P.O. BOX 70, Lafayette, CO 80026 Fax: 303-666-5540 Phone: 303-666-5530

HANFORD TANK WASTE TREATMENT AND IMMOBILIZATION PLANT (WTP)
LAW THERMAL CATALYTIC OXIDIZER
TCO GENERAL ARRANGEMENT

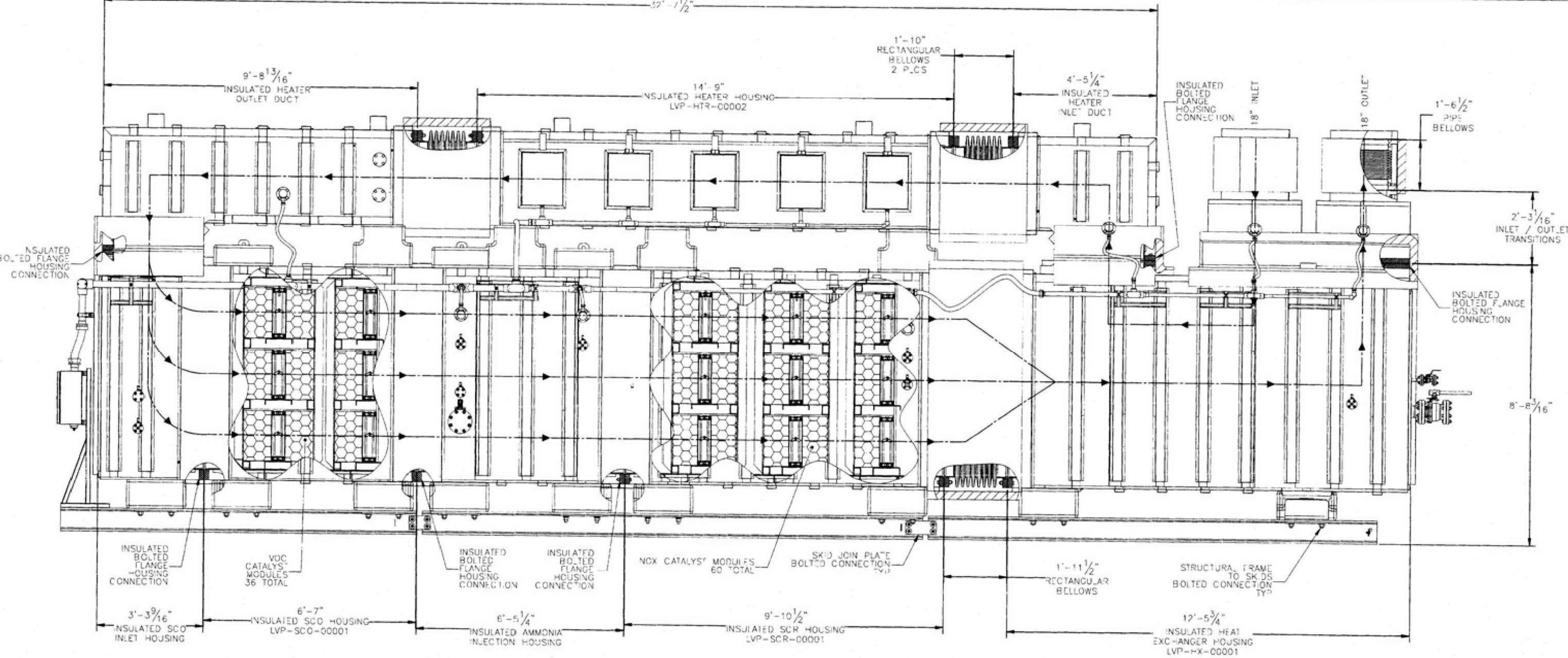
TOLERANCES: FRACTIONS ± 1/8; DECIMALS .X ± .2, .XX ± .12, .XXX ± .062; ANGLES ± 2°

DRAWN	NS	2/10/2014
CHECKED	RP	2/25/2014
APPROVED	MP	2/25/2014

913040 | SIZE D | DWG NO 913040-010-001 | REV D

DO NOT SCALE DRAWING — SCALE: NONE

REVISIONS					
REV.	DESCRIPTION	REV BY	CHK'D BY	APPROVED BY	DATE
A	[illegible]	FV	[illegible]	[illegible]	[illegible]
B	[illegible]	FV	[illegible]	[illegible]	[illegible]
C	[illegible]	NS	[illegible]	[illegible]	[illegible]
D	CHANGED ALL DIMENSIONS TO COLUMN LINES TO BE REFERENCE ON SHEETS 3 & 4	NS	[illegible]	[illegible]	[illegible]



ELEVATION VIEW

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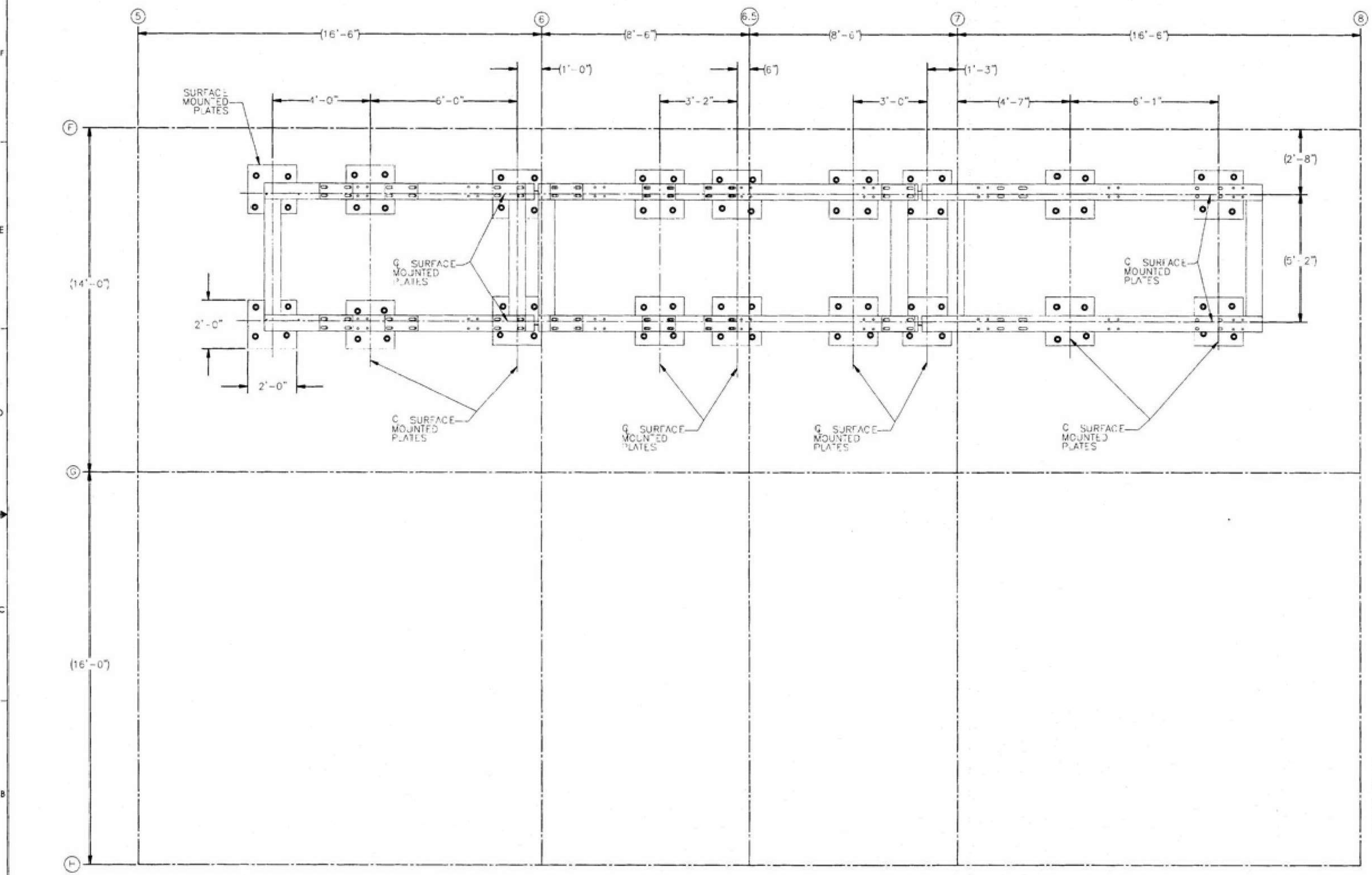
24590-CD-POC-MBTO-00007-01-00353 00E

CUSTOMER: BECHTEL NATIONAL INC.	CONTRACT NO.: 24590-CD-POC-MBTO-00007	IONEX, P.O. BOX 70, Lafayette, CO 8002x, Fax: 303-666-5560, Phone: 303-666-5510
CLIENT: DOE-ORP	COMPONENT NO.: 24590-LAW-MX-LVP-SKID-00002	
	PROJECT LOCATION: WASHINGTON STATE, 200 EAST AREA OF THE HANFORD SITE	
	EQUIPMENT SERVICE: LVP OFFGAS SYSTEM	
FRACTIONS ±1/2; .X ± .2, .XX ± .12, .XXX ± .062; ANGLES ± 2°	DRAWN: NS 2/10/2014	HANFORD TANK WASTE TREATMENT AND IMMOBILIZATION PLANT (WTP) **LAW THERMAL CATALYTIC OXIDIZER**
	CHECKED: RP 2/25/2014	**TCO GENERAL ARRANGEMENT**
	APPROVED: MP 2/25/2014	ORDER NO. 913040; SIZE D; DWG. NO. 913040-010-001; REV. D
	DO NOT SCALE DRAWING	SCALE: NONE

REVISIONS

REV	DESCRIPTION	REV BY	CHKD BY	APPROVED BY	DATE
A	ADDED NOTES FOR INSULATING BLANKETS AROUND ALL [illegible]	FV	[illegible]	[illegible]	[illegible]
B	ADDED COG & RELATED DIMENSIONS, ADDED APPROXIMATE WEIGHT, CORRECTED CATALYST MODULES NOTES (ELEVATION VIEW SHEET 1), UPDATED VIEWS TO REFLECT SUBASSEMBLY DESIGN UPDATE, ADDED NOTE 2 (SHEET 1)	FV	[illegible]	[illegible]	[illegible]
C	UPDATED ALL DRAWING VIEWS FOR CURRENT DESIGN LAYOUT, REMOVED [illegible] DIMENSION TO DETAIL 1	[illegible]	[illegible]	[illegible]	[illegible]
D	CHANGED ALL DIMENSIONS TO COLUMN LINES TO BE REFERENCE ON SHEETS 3 & 4.	[illegible]	[illegible]	[illegible]	[illegible]



EMBED LOCATIONS/ROOM LAYOUT
PLAN VIEW

(REF BNI DWG 24590-LAW-DB-S13T-00135)
(REF BNI DWG 24590-LAW-DD-S13T-00306)
(REF BNI DWG 24590-LAW-DD-S13T-00313)
(REF BNI DWG 24590-BOF-DD-S13T-00001)

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24590-CD-POC-MBT0-00007-01-00353 00E

PARTS LIST

CUSTOMER	BECHTEL NATIONAL INC.
CLIENT	DOE-ORP
[illegible] NO.	24590-CD-POC-MBT0-00007
DOCUMENT NO.	24590-LAW-MX-LVP SKID 00002
PROJECT LOCATION	WASHINGTON STATE, 200 EAST AREA OF THE HANFORD SITE
EQUIPMENT SERVICE	LVP OFFGAS SYSTEM
TOLERANCES	FRACTIONS ±1/8; DECIMALS .X ± .2, .XX ± .12, .XXX ± .062; ANGLES ± 2°
DRAWN	NS 2/10/2014
CHECKED	RP 2/25/2014
APPROVED	MP 2/25/2014

DO NOT SCALE DRAWING

IONEX — P.O. BOX 70, Lafayette, CO 8002x; Fax: 303-666-[illegible]; Phone: 303-[illegible]

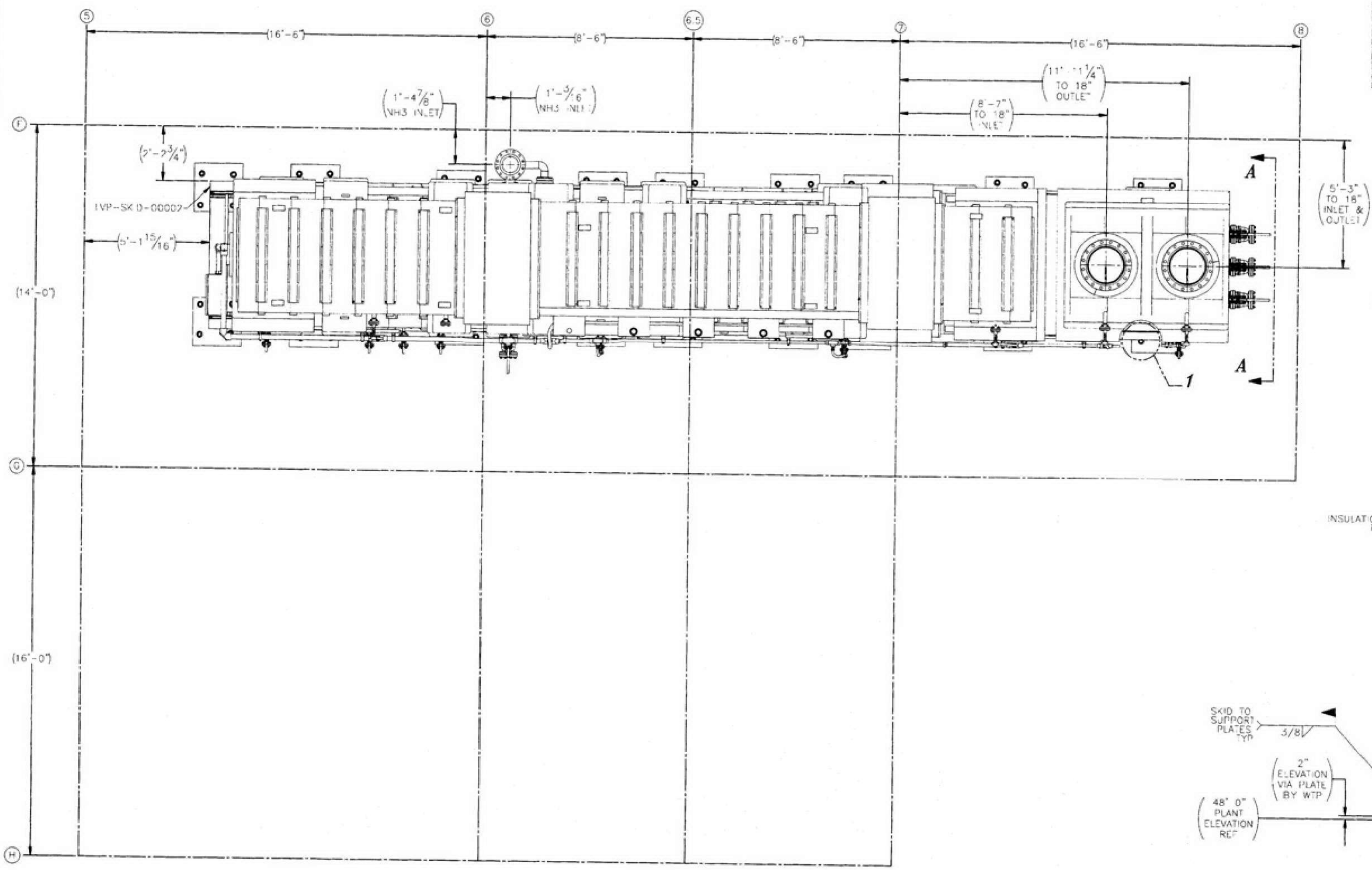
HANFORD TANK WASTE TREATMENT AND IMMOBILIZATION PLANT (WTP)

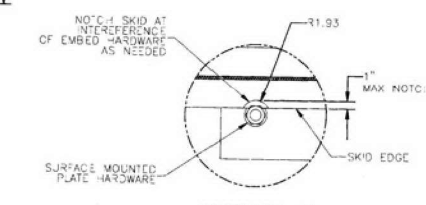
LAW THERMAL CATALYTIC OXIDIZER

TCO GENERAL ARRANGEMENT

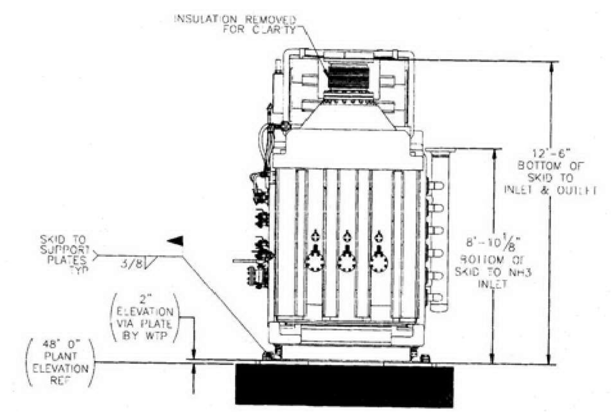
COLLECTION DRAWING NO.	SIZE	DWG. NO.	REV.
913040	D	913040-010-001	D

SCALE NONE | SHEET 3 of 4





DETAIL 1



SECTION A–A

24590-CD-POC-MBTO-00007-01-00353 00E

TCO UNIT LAYOUT ON EMBEDS PLAN VIEW

(REF BNI DWG 24590-LAW-P1-P23T-00052)
(REF BNI DWG 24590-LAW-DD-S13T-00306)

NOTES:

1. LEVEL AND PLUMB LAW TCO. SHIM UNDER THE LAW SUPPORT FRAME AS REQUIRED. WTP CONSTRUCTION TO USE WTP PROVIDED QUALITY LEVEL C CARBON SHIM STOCK.
2. REMOVE PAINT AS NECESSARY TO ACHIEVE FIELD WELD OF SKID TO SURFACE MOUNTED PLATES

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BECHTEL NATIONAL INC.	24590-CD-POC-MBTO-00007
DOE-ORP	24590-LAW-MX-LVP-SKID-00002
	WASHINGTON STATE, 200 EAST AREA OF THE HANFORD SITE
	LVP OFFGAS SYSTEM
±1/2 / .X ± .2 / .XX ± .12 / .XXX ± .062 / ± 2°	DRAWN NS 5/10/2014
	CHECKED RP 2/25/2014
	APPROVED MP 2/25/2014
	DO NOT SCALE DRAWING

IONEX

HANFORD TANK WASTE TREATMENT AND IMMOBILIZATION PLANT (WTP)

LAW THERMAL CATALYTIC OXIDIZER

TCO GENERAL ARRANGEMENT

PRODUCTION ORDER NO.	SIZE	DWG. NO.	REV
913040	D	913040-010-001	D

SCALE NONE

ISSUED BY
RPP-WTP PDC

River Protection Project
Waste Treatment Plant

MECHANICAL DATA SHEET

LAW Catalytic Oxidizer / Reducer

PLANT ITEM No.

24590-LAW-MX-LVP-SKID-00002
24590-LAW-MX-LVP-SKID-00003
(General Note 2)

Data Sheet No.	Rev.
24590-LAW-MKD-LVP-00012	**15**

Project:	**RPP-WTP**	System Description	**Selective Catalytic Oxidizer/Selective Catalytic Reducer**
Project No.:	**24590**		
System No.:	**LVP**	Reference Docs.	**Specification: 24590-LAW-3PS-MBTV-T0001** **References attached below**
Building:	**LAW**		
Quality Level	**Q**	Associated Dwgs.	**24590-LAW-M5-V17T-00011** **24590-LAW-M6-LVP-00005001, 24590-LAW-M6-LVP-00005002** **24590-LAW-P1-P23T-00051, -00052**
Safety Classification	**SS**		
Seismic Category	**SC-III**		

Process Data

Offgas Inlet Conditions:

		2 Melter Nominal	2 Melter Maximum	Design
Vol. Flow *(Process Notes 3, 5)*	(acfm) (scfm)	4,702 2,900	5,395 2,986	6,000 N/A
Mass Flow	lb/hour	12,600	13,000	N/A
Temperature	(°F)	169	189	300 *(Process Note 7)*
Pressure	(in. WG)	-100	-122	-200 *(Process Note 8)*
Density	(lb/ft^3)	0.0447	0.0402	N/A
Allowable Diff. Pressure (in. WG)		8.2 *(Process Note 10)*	9.1 *(Process Note 10)*	12 *(Process Note 10)*

Offgas Inlet Composition:

		2 Melter Nominal	2 Melter Maximum
N_2	(% Volume)	68.2%	67.5%
O_2	(% Volume)	18.3%	18.1%
H_2O	(% Volume)	11.1%	11.5%
CO_2	(% Volume)	1.10%	1.18%
Ar	(% Volume)	0.82%	0.81%

Offgas Outlet Conditions:

	2 Melter Nominal	2 Melter Maximum	Design
Temperature (°F)	* 370*(General Note 3 [TYP])*	412 *(Process Note 2 & 6)*	490 *(Process Note 2)*
Maximum Ammonia Slip, ppm	* 63	200	300

Minor Offgas Components *(Process Note 5)*	2 Melter Nominal, kg/hour	2 Melter Maximum, kg/hour *(Process Note 9)*
NH_3	3.09E-02	6.55E-02
NO *(Process Note 4)*	1.49E+01	2.13E+01
N_2O *(Process Note 4)*	3.97E+00	6.38E+00
NO_2 *(Process Note 4)*	1.98E+01	3.92E+01
CO *(Process Note 4)*	1.07E+00	2.08E-00
SO_2 *(Process Note 1)*	3.16E-02	6.13E-02
Hg	1.97E-04	2.01E-04
HCl	1.53E-03	4.10E-03
HF	8.30E-05	1.22E-04
H_2	3.83E-02	5.01E-02
I_2	5.56E-05	5.56E-05
Particulate	1.24E-05	3.65E-05
VOC/SVOC	5.63E-01	1.17E-00

Process Notes:

1. Maximum SO_2 listed does not include transient spikes.
2. Seller's * process design limit temperature based on the Selective Catalytic Oxidizer/Selective Catalytic Reducer vessel and internal component temperatures using thermodynamic activities in the equipment. * Each of the following locations must be monitored to prevent equipment design temperature (850°F) from being reached.
   a. Seller's process design limit temperature at outlet = 486°F
   b. Seller's process design limit temperature for z-instruments TE-0509 and TE-0516 per Seller = 805°F.
3. Offgas flowrate turn-down ratio of 3:1 required, during planned melter/primary offgas maintenance.
4. Maximum step changes in NO and NO_2 concentrations over a ten-minute period may be as high as 2000 ppmv NO and 1000 ppmv NO_2. Maximum step changes for CO over a 10 minute period may be as high as 500 ppmv. There is no NOx generation during melter idling.

Process Notes (cont'd)

5. Heater sizing for initial heat-up to system operating temperature shall not include contribution from minor offgas components and specified design flow and temperature (inlet conditions).
6. Assumption-70% Heat Exchanger Efficiency.
7. 300F **design inlet temperature is determined by adding a 111F contingency to the 2- melter offgas maximum process temperature supplied to the skid.**
8. Design to 2 psig internal pressure and 7.2 psig external pressure.
9. The constituent concentrations and flowrates are based on the 2-Melter Maximum flowsheet (24590-LAW-M4C-LOP-00001) per 24590-WTP-BODCN-ENG-09-0018.
10. Values supported by BUYER calculations. Margin exists in TCO inlet/outlet piping. See 24590-LAW-MAJ-MS-12-0009, rev 1 for technical justification. Seller to provide nominal, maximum and design differential pressures for BUYER approval.

2 Melter Nominal Differential Pressure per Seller = *14 = (11.89in WG calculated + 2.11in WG margin) in. WG. (Not to Exceed 14 in. WG.)

2 Melter Maximum Differential Pressure per Seller = *15 = (14.35inWG calculated +0.65in WG margin) in. WG. (Not to Exceed 15 in. WG.)

Design Differential Pressure per Seller = * N/A, can't be calculated with values provided in. WG. (Not to Exceed 16 in. WG.)

Ammonia Supply:

		Nominal	Maximum	Design
Temperature	(°F)	77	125	150
Pressure	(psig)	21	45	300
Solids Content	(wt. %)	0 %	0 %	0%

Ammonia Note: Buyer will supply anhydrous ammonia at Seller's specified flowrate to meet design conditions. Seller is responsible for flow control of anhydrous ammonia to meet performance requirements. Ammonia vaporizer assures nominal conditions *(General Note 6)*.

Ammonia Dilution Air Supply:

- Air used for anhydrous ammonia dilution shall be HEPA filtered. Filters are purchased with an efficiency of 99.97% as specified in HEPA Filter Data Sheet **for Standard Nuclear Filters (ASME AG-1 Compliant** Filters), 24590-LAW-MKD-LVP-00015. For operational testing ammonia dilution air shall be HEPA filtered to an efficiency of 99.95%.
- Deleted
- C3V exhaust air temperature shall be maximum 95 °F db / minimum 62 °F wb with an average low pressure of -4 in-WG.

The following are the WTP Dangerous Waste Permit Performance Standards:

1. The Selective Catalytic Oxidizer / Reducer destruction removal efficiency (DRE) for volatile organic compounds (VOCs) and semi-volatile compounds (SVOCs) shall be greater than or equal to 95%. The WTP DRE for VOCs and SVOCs is 99.99%. The principal organic dangerous constituents (PODCs) to be used in LAW performance testing are naphthalene (CAS 00091-20-3) and allyl alcohol (CAS 00107-18-6).
2. The NOx (defined as NO and NO_2) Selective Catalytic Reduction (SCR) unit shall perform with a reduction efficiency of 98%.
3. Dioxin and furan emissions at the stack shall meet the WTP Dangerous Waste Permit Performance Standard criteria of 0.2 ng/m^3 TEQ (Toxic Equivalent).
4. Maximum inlet loading 0.7 grams per minute naphthalene and 1.4 grams per minute allyl alcohol, and a minimum oxidation catalyst outlet temperature of 700°F shall be used for DRE determination *(General Note 9)*.
5. Carbon monoxide (CO) emission shall meet the WTP Dangerous Waste Permit Performance Standard criteria of 100 parts per million (ppm) by volume, over an hourly rolling average, dry basis.
6. Hydrocarbon emission shall meet the WTP Dangerous Permit Performance Standard criteria of 10 parts per million (ppm) by volume, over an hourly rolling average dry basis and reported as propane.

River Protection Project Waste Treatment Plant	MECHANICAL DATA SHEET LAW Catalytic Oxidizer / Reducer	PLANT ITEM No. 24590-LAW-MX-LVP-SKID-00002 24590-LAW-MX-LVP-SKID-00003 *(General Note 2)*

Data Sheet No.	Rev.
24590-LAW-MKD-LVP-00012	15

Approvals

15	Deleted EQ information from this data sheet. Transferred EQ information to data sheets, 24590-LAW-MKQ-M40T-00001 and 00002. **Up dated process note 7. Revised requirements for ammonia dilution air supply. Updated ammonia skid width. Deleted nozzle loads tables and added reference to the calculation number defining the nozzle loads. Updated catalyst weights and references. Margin is not affected. This datasheet summarizes technical data developed in calculations and reports or documented in design basis documents. These documents contain the margin.**	M O'Neill *Accepted No Comments* By: Mike O'Neill - mroneill Org Name: LAW Sys Engr Placed: Oct 22, 2015, 10:44 am	D Rickettson *Originator* By: Dennis J Rickettson - djricket Org Name: Mechanical Systems Placed: Oct 22, 2015, 10:27 am	L Lewis *Checked* By: Lance Lewis - llewis2 Org Name: LAW MH/RE Placed: Oct 22, 2015, 10:35 am	N/A	N/A	G Goolsby	26 oct 15
14	Updated the revision numbers for the corrosion evaluations. Margin is not reduced. Updating revision numbers for the corrosion evaluations does not reduce margin.	M O'Neill	D Rickettson	L Lewis	N/A	N/A	P Rajagopalan	07/01 /15
13	Deleted "Piping" from the Piping /Ducting header. Under Electric Heater section, added "Materials in contact with offgas", deleted enclosure material type & 347SS. Deleted "high temp surface & Instr housing matl", added matl in contact with offgas, added Inconel 800. Revised submittal number 24590-CD-POC-MBT0-00007-01-00386 to 24590-CD-POC-MBT0-00007-01-00353. Revised General Note 11. Margin is not affected. This datasheet summarizes technical data developed in calculations and reports or documented in design basis documents. These documents contain the margin.	M O'Neill	D Rickettson	L Lewis	N/A	N/A	P Rajagopalan	06/18 /15
12	Deleted reference to MACT and replaced with Performance Standards consistant with the DWP. Deleted E&NS Safety Screening Required statement. Updated maximum Heat loss to 17.6 kW. Deleted reference to "General Note 10". Deleted General note 5. Deleted redundant requirement for shipping weights. Added note 1 to EQ section 1.11. Updated references as required.	M O'Neill	D Rickettson	J Marsh	N/A	P Leatherbarrow	S Kretzschmar	03/20 /15

11	Revised the skid height, removed the conceptual design information, deleted component tag numbers, revised the quality level in General Note 5, updated the EQ data sheet to the latest version, added reference list, removed the nozzle loads from the technical notes and added them to the data sheet, added 20% to the nozzle loads per email from Grant Goolsby dated 6/19/14 – CCN: 270007. Major revision, triangles not used for clarity. Margin is not affected. This datasheet summarizes technical data developed in calculations and reports or documented in design basis documents. These documents contain the margin.	Mike O'Neill	D Rickettson	G Goolsby	N/A	Dick Hills	Stuart Kretzschmar	10/21 /14
10	No margin analysis justification is required because these changes do not reduce or eliminate margin (ref. CCN 222685). Revision triangles used. Added technical justification to process note 10. Increased overall length and width due to analyzer probe nozzle addition. Clarified reference points for TCO inlet/outlet height measurement. Revised North arrow for ammonia skid layout. Deleted FILT-00001 from general note 2. Revised section 4.4.3.1. Revised EQD, Section 20. Mounting Method. No margin justification is required because these changes do not reduce or eliminate margin. (Ref. CCN 222685). Revised the Offgas Outlet Minimum Temperature.	M. O'Neill No Comments per email dated 2/24/13	J. Marsh	S. Edwards	D. Krahn Comments resolved per email dated 6/14/13	D. Hills No Comments per email dated 2/12/13	Peter Omel	6/19/ 13
9	Revision triangles used. Complete re-write of the EQD into the new form. Allowable differential pressure has decreased. However, the SELLER indicates the allowable differential pressures are unattainable. Specified inlet/outlet nozzle height. Increased the allowable envelope and shipping height of the Ammonia/Air Dilution Skid per Seller request. Increased the allowable length of the TCO Skid. Decreased Offgas Outlet Design Temperature. Incorporated TCO nozzle design loads to reflect TCN 24590-QL-MRA-MBT0-00007-T0006. Decreased Abnormal High Temp and DBE High Temp per 24590-LAW-M0E-M40T-00007.	M. O'Neill	D. Nelson	J. Wood	D. Krahn	R. Mills	D. Mildon	07-24-12

Rev	Reason for revision	Mech Sys/ Proc. Eng.	Project Equipment	Checked	E&NS	EQ	Approved	Date
8	Revision triangles used. Removed cancelled process calculation 24590-LAW-MEC-LVP-00001. Revised component flowrates to align with 2-Melter Maximum flow sheet guidance per 24590-WTP-BODCN-ENG-09-0018 and ECCN # 24590-LAW-M4E-LOP-00009. Increased the allowable ammonia/air dilution skid height to 11'-0". Specified dilution air flowrate, heat transfer coefficient and heat exchanger area.	M. O'Neill	D. Nelson	M. Parker	D. Krahn	K. Simon	D. Mildon	12-15-11
7	Revision triangles used. Revised Allowable Differential Pressure. Revised Construction Data (Section height, Overall height). Revised catalyst data per manufacturer's and Seller's recommendations. For the EQD portion of the MDS, revised the requisition number, LAW Room datasheet revision number, the area classification "R" value and the chemical exposure details.	M. O'Neill	D. Nelson	D. Rickettson	D. Krahn	K. Simon	J. Schneider	04-18-11
6	Major Revision. Revision triangles not used.	M. O'Neill	T. Valenti	D. Rickettson	D. Krahn	K. Simon	J. Roth	01-12-10
5	Revised General Notes 7 & 8. Revised Process Data. Revised Material Selection for subcomponents based on MET Corrosion Analyses Added reference to LAW C3 Cost Benefit Analysis. Clarified dimensions of skid. Misc. editorial changes.	Mike O'Neill	Josh Wood	Ray Peters	Dwight Krahn	Jeff White	John Julyk	04-Sep-08
4	Added plant item number for ammonia supply skid. Updated quality level designator. Added safety classification. Updated process data. Revised general note 4, added general note 7, 8, & 9. Revised note 5 & 6, and added note 7 for ammonia skid requirements. Revised reference process calculation. Added approval signature block for E&NS. Increased size of ammonia skid sketch for clarity. Added Attachment 1. Added EQ datasheets and Sketch. Added new process data from 24590-LAW-M4C-LOP-00001, Rev. 0. Updated reference P&IDs.	Mike O'Neill	Grant Goolsby	Utpal Sen	Dwight Krahn	Dick Hills	John Julyk	14-Feb-08
3	Revised housing material, system performance and added NOx concentration step change requirement.	R. Hanson	D. Pease	C. Morley	N/A	N/A	M Hoffmann	31-Jul-05
2	Revised pressures and catalyst model number per SDDR 24590-WTP-SDDR-PROC-04-00879. Added dilution air, outlet piping, and ammonia skid requirements.	R. Hanson	D. Pease	C. Morley	N/A	N/A	M. Hoffmann	31-Oct-04
1	Revised Seller Information	J. Rewari / S. Colby	D. Pease	C. Morley	N/A	N/A	M. Hoffmann	6-May-04
0	Issued for Purchase	J. Rewari / S. Colby	D. Pease	E. Isern	N/A	N/A	M. Hoffmann	18-Apr-04

River Protection Project Waste Treatment Plant	MECHANICAL DATA SHEET LAW Catalytic Oxidizer / Reducer	PLANT ITEM No. 24590-LAW-MX-LVP-SKID-00002 24590-LAW-MX-LVP-SKID-00003 *(General Note 2)*	
		Data Sheet No.	Rev.
		24590-LAW-MKD-LVP-00012	15

Mechanical Data (Buyer)

Construction Data:

Process Equipment Dimensions (L x W x H):

Sections (Applicable Only to SCO/SCR skid components/sections that will require replacement prior to 40 years)	15'-6" x 9'-0" x 13'-0"	ft
Overall-Less Maximum TCO Inlet/Outlet Expansion Joint Height (See Below)	44'-6" x 10'-0" x 13'-0"	ft
TCO Inlet/Outlet Expansion Joint Height (Maximum-From Frame Base to Top of Inlet/Outlet Bellows Flanges)	12'-6"	ft
Operating Weight	*103,000 (est.)	lb
Shipping Dimensions	*Length: 13.5 (Heater) Width: 6.5 (Heat Ex.) Height: 8.5 (Heat Ex.) (est.)	ft
Shipping Weight	*20,000 (est)	lb

Ammonia/ Air Dilution Equipment (L x W x H):

Skid dimensions with dilution air fans	13'-0" x 9'-6" x 12'-0"	ft
Skid dimensions without dilution air fans	N/A	ft
Operating Weight	*18,000 (est.)	lb
Shipping Dimensions	13'-0" x 9'-6" x 12'-0"	ft
Shipping Weight	*18,000 (est.)	lb

Thermal Analysis Data:

Room Temperature	59-95	°F
Room Temperature Under Floor	59-95	°F
Maximum Heat Loss	17.6	kW

Concrete Slab Base Thickness	10	in
Thermal Conductivity of Concrete Slab	1.8	W / m-K
Room Pressure Atm. Less	0.2	in-WG

Thermal Cycling Frequency:
Per 24590-WTP-MVC-50-00009, Rev 00B, use a thermal cycle total of 100 for the life of the plant (40 years).

Volatile Organic DRE	*95	%
NOx Reduction	*98	%
NOx emissions, max	*160	ppmvw
Ammonia slip, max	*200	ppmvw
Ammonia/NOx molar injection ratio	*4:3	
Overall Pressure drop through Oxidizer	*10.9 (dP=SCO+SCR)	in-WG
Minimum service life catalyst:		
Oxidation Catalyst	*3	yrs (EST.)
NOx Catalyst	*3	yrs (EST.)

Semi-Volatile Organic DRE		*95	%
Ammonia consumption, max		*89	lb/hr
Ammonia entering injection chamber:	Pressure	*15.8	in-WG
	Flow	*92	lb/hr
	Temp.	*96	°F
Dilution Air entering injection chamber:	Pressure	*15.8	in-WG
	Flow	800	scfm

System Performance (Seller, *General Note 1*)

Nozzle Loading (Buyer)

LAW TCO Nozzle Design Loads (LVP-SKID-00002) are defined in calculation, 24590-LAW-MVC-LVP-00004.

Ammonia / Air Dilution Design Nozzle Loads (LVP-SKID-00003) are defined in calculation, 24590-LAW-S0C-S15T-00030.

Components (Seller, *General Note 1*)

Catalyst:	Organic (LVP-SCO-00001)	NO_x (LVP-SCR-00001)
Manufacturer	BASF (VOCat 300S) "Source Controlled"	*BASF NOxCat VNX-300
Number of reactors	1	1
Number of catalyst modules per layer	*12	*12
Residence time (at standard conditions), seconds, minimum.	0.77 *(General Note 8)*	*0.91
Arrangement	*4 wide x 3 high	*4 wide x 3 high
Total reactor catalyst volume, cubic feet, minimum.	39/ * 39.6 (actual)	*59
Type	Precious metal - platinum	*Vanadium/Titanium
Material: base/substrate	Ceramic - cordierite	*Ceramic - cordierite
Total Number of layers per reactor	3	4/ *5 (actual)
Thickness of layer, in	*10	*9
Space provided between layers for remixing	Yes	*Yes
Space for additional layer, in	No	*No
Is dummy layer provided	No	*No
Number of flow passages	230 cpsi	*64 cpsi
Flow passage, in. x in.	0.060" x 0.060"	*0.11" x 0.11"
Face velocity thru reactor, fpm	*639	*750
Catalyst Section Pressure Drop, in WG	*6.72	*4.18
Inlet Offgas Temperature for MACT Performance Testing, °F	720 (Min) - 750 (Maximum)	*607-631
Design temp, °F	* 850	* 850
Catalyst Module Dimensions, (L x W x D)	*18" x 12" x 10"	*18" x 12" x 9"
Catalyst Module weight, lb	*** 65.8**	*** 57.7**
Total weight of catalyst reactor, lb	*** 2,369**	*** 3,462**

Components (Seller, *General Note 1*)

Housing:	LVP-SCO-00001	LVP-SCR-00001
Material Type	347 SS	347 SS
Material/Thickness, in	*3/8	*3/8
Number of Sections	*1	*1
Weight of Heaviest Section, lb	*10,100 (est.)	*16,300 (est.)
Insulation	*	*
Material/Thickness, in	*	*
Corrosion Allowance, in *(General Note 11)*	0.010	0.010
Thermal Cond, Btu-in/hr ft^2 °F	*	*
Method of Attachment	*Studs with clips	*Studs with clips
Design pressure, psig (internal/external)	* See Offgas Inlet Conditions on Page 1	
Operating pressure, psig	*See Offgas Inlet Conditions on Page 1	
Design temperature, °F	* 850	

Components (Seller, *General Note 1*)

Ducting:	**Inlet**	**Outlet**
Material/Thickness, in	*3/8	*3/8
Cross Section, ft x ft	*47 – 1/8" x 26"	*47-1/8" x 26"
Duct Velocity, fpm	*1143	*1203
Design Temperature, °F	*850	*850
Electric Heater (LVP-HTR-00002)		
Manufacturer	*	
Type	*Tubular elements	
Number of Heat Zones	*5	
Watt Density, W/in^2	*8.5	
Power, kW	*310	
Voltage/Current rating	*480V / TBD	
Housing Material Type	*347 SS	
Materials in contact with offgas, Corrosion Allowance, in *(General Note 11)*	0.010	
Heating Elements	Incoloy 800	
Materials in contact with offgas	347 SS, Incoloy 800	
Design Temperature °F	*850	
Recuperative Heat Exchanger (LVP-HX-00001)		
Manufacturer	*Munters Corporation – DES Champs Products	
Type	*Plate/Frame	
Structural Support Material Type	*347 SS	
Cold Side Components & Enclosure Material Type	347 SS	
Hot Side Plate/Membrane Material Type	347 SS	
Heat transfer coefficient, Btu/hr ft^2 °F-Minimum	3.4	
Heat exchange area, ft^2-Minimum	3105	
ΔT (LMTD) °F	*152 (est.)	
Heat Exchanger duty, Btu/hr	*1,844,030 (est.)	
Corrosion Allowance, in *(General Note 11)*	0.010	
Design Temperature °F	* 850	
Ammonia Injection Manifold:		
Type/Arrangement	*3" injection pipes, horizontal	
Feed Inlet Dia. in	*8	
Supply Pressure/Temp (psi/°F)	*0.57 psig / 96°F (at manifold)	
Material Type (SCR Piping)	347 SS (Vessel Internals) 316L SS (External to Vessel)	
No. of nozzle bars per manifold	*6	
No. of nozzles per bar	*1,138	
Spacing between nozzles, in	*Vertical: 15° / Horizontal: ½" staggered	
Nozzle opening diameter, in	*0.1	

LVP-SKID-00002, Catalytic Oxidizer/Reducer Skid Layout

This sketch has been replaced by 24590-CD-POC-MBT0-00007-01-00353

LVP-SKID-00003, Ammonia/Air Dilution Skid Layout

This sketch has been replaced by 24590-CD-POC-MBT0-00007-01-00175.

General Notes

1. Seller to confirm values and specify specific model numbers for components listed.
2. LVP-SKID-00002 is the catalytic oxidizer/ reducer unit, and is made up of sub component tag numbers:

   24590-LAW-LVP-HX-00001
   24590-LAW-LVP-HTR-00002
   24590-LAW-LVP-SCO-00001
   24590-LAW-LVP-SCR-00001

   LVP-SKID-00003 is the ammonia supply and air dilution equipment and piping, and includes sub component tag numbers:

   24590-LAW-LVP-FAN-00001 & 00002
   Deleted
   Deleted
   24590-LAW-LVP-HEPA-00004A/B
   Deleted

3. Data marked with an asterisk * is, or will be, provided by Seller.
4. Equipment on LVP-SKID-00002 is Dangerous Waste Permit Affecting.
5. Deleted
6. Ammonia supply design pressure shall be applied to the design of the dilution air piping, up to and including valve YV-0538, and to the combined ammonia/air piping up to nozzle N04.
7. Equipment location is shown on Drawings 24590-LAW-P1-P23T-00051 and 24590-LAW-P1-P23T-00052.
8. Oxidation catalyst residence time is based on pilot plant performance at the Catholic University's Vitreous State Laboratory (VSL). Reference: Regulatory Off-Gas Emissions Testing on the DM1200 Melter System Using HLW and LAW Simulants, 24590-101-TSA-W000-0009-166-00001.
9. Organic loading is based on pilot plant performance at the Catholic University's Vitreous State Laboratory (VSL). Reference *Regulatory Off-Gas Emissions Testing on the DM1200 Melter System Using HLW and LAW Simulants*, 24590-101-TSA-W000-0009-166-00001 and *Small Scale Melter Testing for Allyl Alcohol Method Verification*, 24590-101-TSA-W000-0009-195-00002.
10. Deleted
11. Reference Corrosion Evaluations, 24590-LAW-N1D-LVP-00005, -00006, -00007 and -00008. No corrosion allowance for heating elements. Heaters are designed for replacement. Expected life of the heaters is nominally 5 years.

REFERENCES for Data Sheet: 24590-LAW-MKD-LVP-00012, Rev 15 (For BNI Use only)

Data	Document #	Rev	Document Title
Quality Level	24590-LAW-M6-LVP-00005001 24590-LAW-M6-LVP-00005002	3 3	*P&ID – LAW Secondary Offgas/Vessel Vent Process System Ammonia Dilution Skid* *P&ID-LAW-Secondary Offgas/Vessel Vent Process System SCO/SCR Skid*
Seismic Category	24590-LAW-M6-LVP-00005001 24590-LAW-M6-LVP-00005002	3 3	*P&ID – LAW Secondary Offgas/Vessel Vent Process System Ammonia Dilution Skid* *P&ID-LAW-Secondary Offgas/Vessel Vent Process System SCO/SCR Skid*
2 Melter Maximum Flow Rate	24590-LAW-MKC-LVP-00003	1	*LAW Catalytic Oxidizer/Reducer Skid Inlet Operating Conditions and Design Requirements, page 7*
Design Volumetric Flow Rate	24590-LAW-MKC-LVP-00003	1	*LAW Catalytic Oxidizer/Reducer Skid Inlet Operating Conditions and Design Requirements, page 9*
2 Melter Nominal Inlet Temperature	24590-LAW-MKC-LVP-00003	1	*LAW Catalytic Oxidizer/Reducer Skid Inlet Operating Conditions and Design Requirements, page 7*
2 Melter Maximum Inlet Temperature	24590-LAW-MKC-LVP-00003	1	*LAW Catalytic Oxidizer/Reducer Skid Inlet Operating Conditions and Design Requirements, page 7*
Design Inlet Temperature	**24590-LAW-M4E-LOP-00009**	N/A	*LAW Melter Offgas System Design Basis Flow Sheets, Page 15*
Maximum Outlet Temperature	24590-LAW-MKC-LVP-00003	1	*LAW Catalytic Oxidizer/Reducer Skid Inlet Operating Conditions and Design Requirements, page 3*
Design Outlet Temperature	24590-LAW-MKC-LVP-00003	1	*LAW Catalytic Oxidizer/Reducer Skid Inlet Operating Conditions and Design Requirements, page 7*
2 Melter Nominal Pressure	24590-LAW-MKC-LVP-00003	1	*LAW Catalytic Oxidizer/Reducer Skid Inlet Operating Conditions and Design Requirements, page 7*
2 Melter Maximum Pressure	24590-LAW-MKC-LVP-00003	1	*LAW Catalytic Oxidizer/Reducer Skid Inlet Operating Conditions and Design Requirements, page 7*
Design Inlet Pressure (Vacuum)	24590-LAW-MKC-LVP-00003	1	*LAW Catalytic Oxidizer/Reducer Skid Inlet Operating Conditions and Design Requirements, page 8*
Allowable Differential Pressure (Nominal)	24590-LAW-M4E-LOP-00009	N/A	*LAW Melter Offgas System Design Basis Flow Sheets, Page 11*
Allowable Differential Pressure (Maximum)	24590-LAW-M4E-LOP-00009	N/A	*LAW Melter Offgas System Design Basis Flow Sheets, Page15*
Allowable Differential Pressure (Design)	24590-LAW-MKC-LVP-00003	1	*LAW Catalytic Oxidizer/Reducer Skid Inlet Operating Conditions and Design Requirements, page 9*
2 Melter Maximum Mass Flow	24590-LAW-M4E-LOP-00009	N/A	*LAW Melter Offgas System Design Basis Flow Sheets, Page15*
2 Melter Maximum Density	24590-LAW-M4E-LOP-00009	N/A	*LAW Melter Offgas System Design Basis Flow Sheets, Page 15*
2 Melter Nominal Mass Flow	24590-LAW-M4E-LOP-00009	N/A	*LAW Melter Offgas System Design Basis Flow Sheets, Page 11*
2 Melter Nominal Density	24590-LAW-M4E-LOP-00009	N/A	*LAW Melter Offgas System Design Basis Flow Sheets, Page 11*
2 Melter Nominal Volumetric Flow	24590-LAW-M4E-LOP-00009	N/A	*LAW Melter Offgas System Design Basis Flow Sheets, Page 11*
2 Melter Nominal Offgas Composition	24590-LAW-M4E-LOP-00009	N/A	*LAW Melter Offgas System Design Basis Flow Sheets, Pages 12-14*

REFERENCES for Data Sheet: 24590-LAW-MKD-LVP-00012, Rev 15 (For BNI Use only)

2 Melter Maximum Offgas Composition	24590-LAW-M4E-LOP-00009	N/A	*LAW Melter Offgas System Design Basis Flow Sheets, Pages 16-18*
Ammonia Supply Conditions	24590-LAW-M6WX-LVP-00005001	2	*MS Line List for P&ID 24590-LAW-M6-LVP-00005001, Page 1*
Maximum Ammonia Slip	24590-LAW-M4E-LOP-00009	N/A	*LAW Melter Offgas System Design Basis Flow Sheets, Page 17*
Design Ammonia Slip	24590-LAW-MKC-LVP-00003	1	*LAW Catalytic Oxidizer/Reducer Skid Inlet Operating Conditions and Design Requirements, page 6*
VOC Removal Efficiency	24590-WTP-DB-ENG-01-001	2	*Basis of Design, Section 14.4.3.3*
Maximum Offgas Inlet Composition	24590-LAW-M4E-LOP-00009	N/A	*LAW Melter Offgas System Design Basis Flow Sheets, page 16*
Minor Offgas Components	24590-LAW-M4E-LOP-00009	N/A	*LAW Melter Offgas System Design Basis Flow Sheets, pages 17 and 18*
Mechanical Data – Ammonia / Air Dilution Skid	24590-CD-POC-MBT0-00007-01-00042	00D	*LAW Ammonia / Air Dilution Skid General Arrangement*
Nozzle Loads LVP-SKID-00002	24590-LAW-MVC-LVP-00004	00A	*LVP-SKID-00002, LAW Thermal Catalytic Oxidizer / Reducer, Stress Analysis with ANSYS*
Nozzle Loads LVP-SKID-00003	24590-LAW-S0C-S15T-00030	00A	*LAWTCO Ammonia/Air Dilution Skid Analysis*
Deleted			
Catalyst Data (Organic)	24590-CD-POC-MBT0-00007-03-00003	00D	*Data Sheet – Selective Catalytic Oxidation(SCO) Catalyst*
Catalyst Data (NOx)	24590-CD-POC-MBT0-00007-03-00004	00D	*Data Sheet – Selective Catalytic Reduction (SCR) Catalyst*
Nominal and Maximum Pressure Differential	24590-CD-POC-MBT0-00007-02-00001	00E	*Calculation – Mass & Energy Balance for LAW Catalytic Oxidizer / Reducer*
LVP-SCR-00001 Material Type and Corrosion Allowance	24590-LAW-N1D-LVP-00008	3	*LVP-SCR-00001 (LAW) – NOx Selective Catalytic Reducer*
LVP-SCO-00001 Material Type and Corrosion Allowance	24590-LAW-N1D-LVP-00007	4	*LVP-SCO-00001 (LAW) – Thermal Catalytic Oxidizer*
LVP-HTR-00002 Material Type and Corrosion Allowance	24590-LAW-N1D-LVP-00006	3	*LVP-HTR-00002 (LAW) – Catalytic Oxidizer Electric Heater*
LVP-HX-00001 Material Type and Corrosion Allowance	24590-LAW-N1D-LVP-00005	3	*LVP-HX-00001 (LAW) – Catalytic Oxidizer Heat Recovery Exchanger*
Construction Data	24590-CD-POC-MBT0-00007-03-00001	00C	*Data Sheet – Mechanical Data Sheet, LAW Catalytic Oxidizer/Reducer*
Electric Heater	24590-CD-POC-MBT0-00007-03-00009	00F	*Data Sheet – Electric Heater, LAW TCO*
Recuperative Heat Exchanger	24590-CD-POC-MBT0-00007-03-00008	00D	*Data Sheet – Heat Exchanger Core, LAW TCO*

REFERENCES for Data Sheet: 24590-LAW-MKD-LVP-00012, Rev 15 (For BNI Use only)

Vendor Provided Data	24590-CD-POC-MBT0-00007-03-00001	00C	*Data Sheet - Mechanical Data Sheet, LAW Catalytic Oxidizer / Reducer*
Maximum Heat Loss	24590-LAW-MVC-LVP-00004	00A	*LVP-SKID-00002, LAW Thermal Catalytic Oxidizer / Reducer, Stress Analysis with ANSYS*
Point of Support	**24590-LAW-P1-P23T-01009001**	**0**	***LAW Vitrification Building Equipment Location Point of Support Schedule Elevation 48'-0" Sheet 1 of 2***

Attachment 2
15-ECD-0059
(2 Pages)

U.S. Department of Energy, Office of River Protection
And Bechtel National, Inc.'s Certifications
For the
Submittal of Dangerous Waste Permit Package LAW-025,
Thermal Catalytic Oxidizer/Selective Catalytic Reducer

U.S. Department of Energy, Office of River Protection Certification

The following certification statement is provided for the submittal of the Hanford Facility Resource Conservation and Recovery Act Permit Modification Notification LAW-025 Engineering Documentation.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

K. W. Smith, Manager for
U.S. Department of Energy,
Office of River Protection

12/9/15
Date

Bechtel National, Inc. Certification

The following certification statement is provided consistent with Contract No. DE-AC27-01RV14136, Section H.26, Environmental Permits, paragraph (g) for the submittal of the Hanford Facility Resource Conservation and Recovery Act Permit Package LAW-025 Engineering Documentation

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Margaret G. McCullough — Dec. 2, 2015

M. G. McCullough
Project Director

Date